The Electrochemical Society • • •

107th Meeting

CINCINNATI
May 1st-5th, 1955

LOCAL COMMITTEE

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MRS. CARL TAGLAUER

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THE ELECTROCHEMICAL SOCIETY

One Hundred and Seventh Meeting

Sunday through Thursday

May 1, 2, 3, 4, and 5, 1955

CONDENSED TECHNICAL PROGRAM

Electric Insulation (Abs. 1-28)
(All sessions in Parlors 4 and 5)

Monday, May 2 — 9:30 A.M.-11:45 A.M.
Monday, May 2 — 2:00 P.M.-5:00 P.M., including Round-Table Discussion
Tuesday, May 3 — 9:00 A.M.-11:30 A.M.
Tuesday, May 3 — 2:00 P.M.-4:00 P.M.
Wednesday, May 4 — 9:00 A.M.-12:15 P.M.
Wednesday, May 4 — 2:00 P.M.-4:30 P.M.

Electronics--Luminescence (Abs. 29-54)

Tuesday, May 3 -- 9:10 A.M.-12:00 M. (Victory Room)
Tuesday, May 3 -- 2:00 P.M.-5:00 P.M. (Victory Room)
Wednesday, May 4 -- 9:00 A.M.-12:20 P.M. (Parlor 7)
Wednesday, May 4 -- 2:00 P.M.-5:00 P.M. -- Round-Table Discussion (Parlor 7)

Electronics--Oxide Cathodes (Abs. 55-71)
(All sessions in Parlor 7)

Monday, May 2 -- 2:00 P.M.-5:00 P.M.
Tuesday, May 3 -- 9:30 A.M.-12:00 M.
Tuesday, May 3 -- 2:00 P.M.-5:00 P.M., including Round-Table Discussion

Electronics--Phosphor Application (Abs. 72-76)
(All sessions in Parlor 7)

Thursday, May 5 -- 9:30 A.M.-12:30 P.M.
Thursday, May 5 -- 2:00 P.M.-5:00 P.M. -- Round-Table Discussion

Electronics--Semiconductors (Abs. 77-100)
(All sessions in Victory Room)
Wednesday, May 4 -- 9:00 A.M.-12:00 M.
Wednesday, May 4 -- 2:00 P.M.-6:00 P.M.
Thursday, May 5 -- 9:00 A.M.-12:30 P.M.
Thursday, May 5 -- 2:00 P.M.-5:00 P.M.

Electrothermics and Metallurgy (Abs. 101-125)
(All sessions in Parlors 8 and 9)
Monday, May 2 -- 9:15 A.M.-11:15 A.M.
Monday, May 2 -- 2:30 P.M.-4:00 P.M.
Tuesday, May 3 -- 2:00 P.M.-5:00 P.M.
Wednesday, May 4 -- 9:00 A.M.-12:00 M.
Wednesday, May 4 -- 2:00 P.M.-5:00 P.M.

Industrial Electrolytic (Abs. 126-138)
Monday, May 2 -- 9:15 A.M.-12:15 P.M.
(Victory Room)
Monday, May 2 -- 2:00 P.M.-5:00 P.M. --
Round-Table Discussion (Victory Room)
Tuesday, May 3 -- 9:00 A.M.-12:00 M.
(Ballroom)

Theoretical Electrochemistry and
Industrial Electrolytic (Abs. 139-152)
(All sessions in Foyer, Roof Garden)
Wednesday, May 4 -- 2:00 P.M.-4:30 P.M.
Thursday, May 5 -- 9:00 A.M.-12:00 M.,
including Round-Table Discussion
Thursday, May 5 -- 2:00 P.M.-4:30 P.M.

Theoretical Electrochemistry (Abs. 153-184)
(All sessions in Foyer, Roof Garden)
Monday, May 2 -- 9:15 A.M.-12:00 M.
Monday, May 2 -- 2:00 P.M.-5:00 P.M.
Tuesday, May 3 -- 9:00 A.M.-11:30 A.M.
Tuesday, May 3 -- 2:00 P.M.-5:00 P.M.
Wednesday, May 4 -- 9:00 A.M.-11:30 A.M.

GENERAL INFORMATION

Convention Headquarters will be at the Hotel Sheraton-Gibson, Fourth and Walnut Streets, Cincinnati, Ohio.

Rates per day for rooms will be: single room for one: $5.35, 5.85, 6.35, 6.85, 7.35, 7.85, 8.85, 9.85 and up; double-bed room for two: $8.35, 8.85, 9.35, 9.85, 10.35, 12.85; twin-bed room for two: $9.35, 10.35, 10.85, 11.85, 12.85, 15.85, 16.85; parlor suites (two rooms): $21.35, 24.35 to 60.00. All rooms are equipped with radio, tub or shower-bath, and most rooms have air-conditioning and TV sets.

Requests for room reservations should be made to: Mark Schmidt, General Manager, Sheraton-Gibson Hotel, Cincinnati 1, Ohio, with mention of The Electrochemical Society.

The Secretary will have his office in Society Headquarters in Parlor 6 on the Mezzanine.

Technical Sessions will be held on the Lower Lobby floor, the Mezzanine floor, the Ballroom floor, and the Roof Garden of the Hotel, as designated in the Program Booklet.

Ladies' Headquarters will be in Parlor H on the Ballroom floor throughout the meeting. The ladies are asked to meet here for the various functions listed under the Ladies' Program.

REGISTRATION

The registration desk will be located on the Mezzanine floor of the Hotel. On Sunday, May 1, the registration desk will be open from 4:00 P.M. to 6:00 P.M. On Monday, Tuesday, and Wednesday, it will be open from 8:00 A.M. to 4:00 P.M.; on Thursday from 8:00 A.M. to 12:00 M. Registration fees are:

Members.....$7.00	Students....$2.00
Ladies.....$3.00	Nonmembers..$10.00

INFORMATION ABOUT CINCINNATI

Information and descriptive matter on points of interest, theaters, dining, dancing, and entertainment in Cincinnati and Northern Kentucky will be available at the registration desk. These will include "Cincinnati Welcomes You" booklets, "Your Host" a guide to Greater Cincinnati, and maps and information concerning places to visit and sightseeing trips for Convention visitors.

Built upon seven hills, Cincinnati is one of America's most picturesque big cities. Visitors appreciate, perhaps more than its natives, panoramic views from hilltop parks and streets, stern-wheelers churning the Ohio River, and 1001 other sights around the town.

The following may be included in the Convention itinerary: Scenic drives, the Conservatory Garden in Eden Park, Cincinnati Zoological Gardens, Taft Museum, Cincinnati Art Museum, the Carew Tower, Ault Park, the Cincinnati Reds, University Centers, theaters, dining and dancing at downtown restaurants, and hotels or supper clubs in Cincinnati and Northern Kentucky.

The Sheraton-Gibson, Cincinnati's leading convention hotel, is located at Fourth and Walnut Streets in the heart of the downtown area. Fronting on historic Fountain Square with the famous Tyler-Davison Fountain, it is most convenient to business, shopping, and theatrical districts.

ROUND-TABLE DISCUSSIONS AND SPECIAL SYMPOSIA

There will be six round-table discussions:

Electric Insulation on Monday, May 2, at

3:30 P.M. in Parlors 4 and 5; Electronics--Luminescence on Wednesday, May 4, at 2:00 P.M. in Parlor 7 (Mezzanine); Electronics--Oxide Cathodes on Tuesday, May 3, at 4:00 P.M. in Parlor 7 (Mezzanine); Electronics--Phosphor Application on Thursday, May 5, at 2:00 P.M. in Parlor 7 (Mezzanine); Industrial Electrolytic on Monday, May 2, at 2:00 P.M. in the Victory Room (Lower Lobby); Industrial Electrolytic and Theoretical Electrochemistry on Thursday, May 5, at 10:30 A.M. in the Foyer, Roof Garden.

The Industrial Electrolytic and Theoretical Electrochemistry Divisions are holding joint sessions on Fused Electrolytes on Wednesday, May 4, at 2:00 P.M., and Thursday, May 5, at 9:00 A.M. and 2:00 P.M. in the Foyer, Roof Garden.

The Electrothermics and Metallurgy Division will hold special symposia on: Oxidation and Corrosion on Tuesday, May 3, at 2:00 P.M.; Electrochemical Techniques in Metallurgical Research on Wednesday, May 4, at 9:00 A.M. and 2:00 P.M., in Parlors 8 and 9 (Mezzanine).

LUNCHEONS AND DINNERS

Monday Evening Buffet Supper and Entertainment

Monday evening, May 2, has been reserved for an informal get-together and entertainment. Cocktails will be served at 6:30 P.M. in the Foyer of the Roof Garden. Buffet Supper with floor show and entertainment in the Roof Garden will follow.

Tuesday Luncheon and Annual Business Meeting

The Electrochemical Society Luncheon and Annual Business Meeting will be held at 12:30 P.M., on May 3, in the Roof Garden. Speaker

will be Dr. Gustav Eckstein, University of Cincinnati, whose talk is entitled "At Arms Length."

Tuesday Evening Reception

and Banquet

A reception for President and Mrs. Udy will be held on Tuesday, May 3, at 6:30 P.M. in the Roof Garden. Following cocktails and an excellent dinner, President Udy will deliver the presidential address.

Wednesday Evening Section Q Meeting

Informal gatherings for poker, bridge, or conversation can convene in the Victory Room (Lower Lobby). All necessary facilities, including refreshments, will be available.

PLANT TRIPS

Participation in plant trips should be arranged ahead of time with the Chairman of the Plant Trip Committee at the registration desk on the Mezzanine Floor of the Hotel. The following plant trips are available:

Tuesday afternoon -- An inspection of the main plant of the Baldwin Piano Company, Gilbert Avenue at Eden Park Entrance, has been arranged. This trip will include inspection of the plant and processes used in the manufacture of pianos and electronic musical instruments. Buses will be available for transportation to and from the Baldwin Piano Company.

Wednesday afternoon -- An inspection of the new Walter C. Beckjord Electric Generating Station of the Cincinnati Gas & Electric Company on the Ohio River near New Richmond, Ohio, has been arranged. This station has a capacity of 325,000 kw and its latest generating and steam units have been placed in service within the past three months. This

modern high-pressure steam station with complete river fuel deliveries, automatic handling and control equipment is worth seeing for its educational value as well as the scenic ride up the Ohio River. Buses will be available to transport those who wish to take this trip to and from New Richmond.

Thursday afternoon -- An inspection trip through the Public Health Center of the Federal Government on Columbia Parkway has been arranged. Buses will be available for transportation to and from the Health Center.

LADIES' PROGRAM

Ladies' Headquarters will be in Parlor H on the Ballroom floor of the Sheraton-Gibson Hotel throughout the Convention. All ladies are requested to visit this headquarters and register for the program which has been arranged for their entertainment and information. The ladies' program has been arranged to cover interesting features of Cincinnati and to provide for participation in entertainment features of the general convention as well as to provide some free time for shopping and individual amusement.

Monday morning -- A get-acquainted meeting with coffee and doughnuts will be held at 10:30 A.M. in Parlor H. At this meeting discussion of arrangements for the features of the ladies' program will be held, as well as an opportunity for the ladies to get acquainted and express their wishes and desires in connection with the program.

Monday afternoon -- A style show, with monologue by Miss Bernice Foley, will be held in Parlor H at 2:30 P.M. Miss Foley is a nationally recognized authority on style and charm, and will bring her knowledge of these arts to the ladies. The style show will be followed by tea.

Monday evening -- The ladies will certainly

want to attend the buffet supper and floor show in the Roof Garden starting at 6:30 P.M.

Tuesday morning and afternoon -- A trip has been arranged to the new Robert A. Taft Engineering Center operated by the U. S. Department of Health, Education and Welfare. Buses will be provided to take the ladies to and from the Engineering Center, leaving the Sheraton-Gibson at 10:30 A.M. All who wish to participate in this trip should make their wishes known in advance so that suitable bus space can be provided. Work at the Center includes air pollution control, water pollution control, radiological experimentation, and environmental health investigations and engineering. Luncheon will be served to the ladies at the Center.

Tuesday evening -- The ladies are invited to attend the President's Reception, cocktails, and dinner on the Roof Garden of the Sheraton-Gibson Hotel at 6:30 P.M.

Wednesday morning and afternoon -- The ladies are invited to participate in a Cincinnati Motorama, leaving the Sheraton-Gibson Hotel at 10:30 A.M. This trip will provide thumbnail views and sketches of interesting points in and around Cincinnati. It will be followed by luncheon at one of the finest restaurants on the famous Dixie Highway across the river in Kentucky. Ladies who wish to participate in this Motorama should make their wishes known in advance so that suitable reservations can be made for them.

Thursday -- Held open for shopping. The ladies are invited to make the Ladies' Headquarters a get-together place for information and advice as to places to visit and things to see and buy.

LUNCHEONS AND BUSINESS MEETINGS OF DIVISIONS

Electric Insulation Division will hold a

luncheon and business meeting on Monday, May 2, at 12:30 P.M. The luncheon will be held in honor of Dr. Andrew Gemant, The Detroit Edison Co., Detroit, Mich., who will make a brief address.

Electronics Division will hold a luncheon and business meeting on Wednesday, May 4, at 12:30 P.M.

Electrothermics and Metallurgy Division will hold a luncheon and business meeting on Wednesday, May 4, at 12:30 P.M.

Industrial Electrolytic Division will hold a luncheon on Monday, May 2, at 12:30 P.M. W. C. Gardiner will give the Chlor-Alkali Report.

Semiconductor Group, Electronics Division will hold a luncheon and business meeting on Thursday, May 5, at 12:30 P.M.

Theoretical Electrochemistry Division will hold a business meeting on Tuesday, May 3, at 11:30 A.M. in the Foyer, Roof Garden.

(Rooms in which luncheons are to be held will be available at the registration desk.)

BOARD AND COMMITTEE MEETINGS

Sunday, May 1, 10:00 A.M. -- Meeting of the Ways and Means Committee in Parlor 6 (Mezzanine).

Sunday, May 1, 2:00 P.M. -- Meeting of the Board of Directors in Parlor 6 (Mezzanine).

Monday, May 2, 4:00 P.M. -- Meeting of the Council of Local Sections in Parlor 6 (Mezzanine).

Tuesday, May 3, 5:00 P.M. -- Meeting of the Sustaining Membership Committee in Parlor 6 (Mezzanine).

Wednesday, May 4, 5:00 P.M. -- Meeting of the Membership Committee in Parlor 6 (Mezzanine).

COST OF VARIOUS FUNCTIONS

(other than registration)

Division Luncheons	$3.60
Monday Cocktails, Buffet Supper, and Entertainment	$6.50
Tuesday Society Luncheon	$3.60
Tuesday Reception, Cocktails, and Dinner	
(single)	$6.50
(couple)	$11.00

JOURNALS

Copies of the January, February, March, and April issues of the Journal of The Electrochemical Society containing some of the papers presented will be available at the registration desk. The price of a single copy of the Journal is $1.25 to members and $1.50 to nonmembers.

EXTENDED ABSTRACTS

The Electronics Division again is making available an extended abstract booklet containing 1000-word abstracts of most of the papers presented at the Division's Cincinnati symposia. Copies of the booklet will be on sale at the registration desk for $2.00.

The Theoretical Electrochemistry Division is also making available a booklet containing 1000-word abstracts of papers presented at the Division's symposia at Cincinnati. Copies of the booklet will be on sale at the registration desk for $2.00.

DISCUSSION

There will be no recordings made of oral discussions. Those contributing to the discussion of a paper and desiring their remarks published can obtain discussion sheets from the symposium Chairman on which discussion may be written. These forms should be given either to the symposium Chairman or to the Secretary-Treasurer of the Division at the end of the session. The discussion will then be referred to the authors for reply. Written discussion will be accepted up to two months following publication of any article in the Journal.

A discussion section is published semi-annually in the Journal.

TECHNICAL PROGRAM

Monday, May 2, 1955

9:00 A.M.--Formal Opening of the 107th Convention, with Introduction by General Chairman Roy O. McDuffie and response by President Marvin J. Udy (Foyer, Roof Garden).

ELECTRIC INSULATION

Monday, May 2, 1955

Radiation and Dielectrics
with R. A. Ruscetta presiding
(Parlors 4 and 5, Mezzanine)

9:30 A.M.--Welcome -- C. F. Miller, Division Chairman.

9:45 A.M.--"The Measurement of Radiation Affecting Insulation" by W. W. Managan, Victoreen Instrument Co., Cleveland, Ohio. (Abstract No. 1)

10:15 A.M.--"Electron Irradiated Polyethylene" by J. R. Stirrat and P. A. Goodwin, General Electric Co., Pittsfield, Mass. (Abstract No. 2)

10:45 A.M.--"Radioactive Isotopes in the Study of Dielectric Degradation" by H. C. Beachell and V. L. Turner, University of Delaware, Newark, Del. (Abstract No. 3)

11:15 A.M.--"Synthesis of Electrical Insulation by Means of Gamma Radiation" by T. D. Callinan, Naval Research Laboratory, Washington, D. C. (Abstract No. 4)

12:30 P.M.--Electric Insulation Division Luncheon and Business Meeting. Luncheon to honor Dr. Andrew Gemant, Detroit Edison Co., Detroit, Mich. Dr. Gemant will make a brief address. Room to be announced.

ELECTRIC INSULATION

Monday, May 2, 1955

Electrical and Mechanical Properties of Plastics

with A. J. Sherburne presiding

(Parlors 4 and 5, Mezzanine)

2:00 P.M.--"Properties of Gafite" by H. D. Anspon, Central Research Labs., General Aniline and Film Corp., Easton, Pa. (Abstract No. 5)

2:30 P.M.--"Casting Resins for the Electrical Trade" by W. E. Harvey, John C. Dolph Co., Monmouth Junction, N. J. (Abstract No. 6)

3:00 P.M.--"Properties of Polyamide-Epoxy Resin Casting Compositions" by Wm. Minarik, General Mills Inc., Minneapolis, Minn. (Abstract No. 7)

ROUND TABLE

with L. L. Deer presiding

(Parlors 4 and 5, Mezzanine)

3:30 P.M.--Round-table Discussion of Casting Resins, with a panel of experts.

ELECTRIC INSULATION

Tuesday, May 3, 1955

Solid Insulation

with M. D. Heyman presiding

(Parlors 4 and 5, Mezzanine)

9:00 A.M.--"Semiceramics" by M. D. Heyman, Integrated Mica Corp., Woodmere, N. Y. (Abstract No. 8)

9:30 A.M.--"Inorganic and Organic Synthetic Fiber Papers for Reinforced Plastic Laminates" by H. F. Arledter, Hurlbut Paper Co., South Lee, Mass. (Abstract No. 9)

10:00 A.M.--"The Manufacture and Properties of a Novel Reinforced Plastic" by J. W. Case, Bureau of Ordnance, Navy Department, Washington, D. C., and J. D. Robinson, Firestone Tire and Rubber Co., Akron, Ohio. (Abstract No. 10)

10:30 A.M.--"Epoxy Resin Glass Base Laminates" by J. C. Pitzer, Formica Co., Cincinnati, Ohio. (Abstract No. 11)

11:00 A.M.--"The Electrical Resistivity of Bonded Micaceous Materials at Elevated Temperatures" by Kenneth Wechsler, Mica Insulator Co., Schenectady, N. Y. (Abstract No. 12)

12:30 P.M.--Society Luncheon and Business Meeting in the Roof Garden.

ELECTRIC INSULATION

Tuesday, May 3, 1955

Electrical Properties of Resins

with J. R. Bukey presiding

(Parlors 4 and 5, Mezzanine)

2:00 P.M.--"The Properties of Exon" by J. R. Bukey, Firestone Plastics Co., Pottstown, Pa. (Abstract No. 13)

2:30 P.M.--"The Electrical Conductivity of Carbon Black Reinforced Elastomers" by Gerard Kraus and J. F. Svetlik, Phillips Petroleum Co., Bartlesville, Okla. (Abstract No. 14)

3:00 P.M.--"Heat Stability of the Resole Type Phenol-Formaldehyde Resins" by A. H. Haroldson, Continental-Diamond Fibre Co., Newark, Del. (Abstract No. 15)

3:30 P.M.--"The Past, Present, and Future of Prefabricated Wiring (Printed Circuits)" by Carl Coy, Consulting Engineer, Tammen and Denison, Chicago, Ill. (Abstract No. 16)

ELECTRIC INSULATION

Wednesday, May 4, 1955

Electrophysics

with T. D. Callinan presiding

(Parlors 4 and 5, Mezzanine)

9:00 A.M.--"Organic Peroxides as Source of Cations" by Andrew Gemant, Detroit Edison Co., Detroit, Mich. (Abstract No. 17)

9:30 A.M.--"Recent Developments in Power and Allied Products" by N. R. Maleady, General Electric Co., Rome, Ga. (Abstract No. 18)

10:00 A.M.--"Recent Developments in Electrical Measurements" by J. A. Connor, Radio Corp. of America, Camden, N. J. (Abstract No. 19)

10:30 A.M.--"Dielectric Properties of Aerosols" by H. C. Thacher, Jr., Aeronautical Research Lab., Wright Air Development Center, Wright-Patterson Air Force Base, Ohio. (Abstract No. 20)

11:00 A.M.--"Effects of Moisture, Temperature, and Frequency on the Electrical Properties of Insulating Materials" by L. J. Frisco, Institute for Cooperative Research, The Johns Hopkins University, Baltimore, Md. (Abstract No. 21)

11:20 A.M.--"Breakdown Phenomena as Related to Other Dielectric Properties" by J. J. Chapman, Institute for Cooperative Research, The Johns Hopkins University, Baltimore, Md. (Abstract No. 22)

11:45 A.M.--"Inhibiting Effects of 2, 6-Di-Tertiary-Butyl Para Cresol on Cellulose Insulation Deterioration" by E. D. Andrews, Koppers Co., Pittsburgh, Pa., and F. C. Doble, Doble Engineering Co., Cambridge, Mass. (Abstract No. 23)

ELECTRIC INSULATION

Wednesday, May 4, 1955

Capacitors

with D. A. Lupfer presiding

(Parlors 4 and 5, Mezzanine)

2:00 P.M.--"Liquid Filled Capacitors" by Sydney Wald, Glenn L. Martin Co., Baltimore, Md. (Abstract No. 24)

2:30 P.M.--"Recent Developments in Electrolytic Capacitors" by Judson West, Jr., Magnavox Co., Fort Wayne, Ind. (Abstract No. 25)

3:00 P.M.--"High Voltage Glass Capacitors" by Gail Smith, Corning Glass Works, Corning, N. Y. (Abstract No. 26)

3:30 P.M.--"Subminiature Capacitors and Other Components" by Louis Kahn, Aerovox Corp., New Bedford, Mass. (Abstract No. 27)

4:00 P.M.--"Capacitors for High Temperature Pulse-Forming Networks" by William Allison, Sprague Electric Co., North Adams, Mass. (Abstract No. 28)

ELECTRONICS--LUMINESCENCE

Tuesday, May 3, 1955

Basic Phenomena

with F. E. Williams presiding

(Victory Room, Lower Lobby)

9:10 A.M.--Introduction of Keynote Speaker by Herbert Bandes, Sylvania Electric Products Inc., Flushing, N. Y.

9:15 A.M.--Keynote Address--"The Theoretical Basis for Photoluminescence, Electroluminescence, and Photoelectroluminescence" by F. E. Williams, Research Lab., General

Electric Co., Schenectady, N. Y.
(Abstract No. 29)

10:00 A.M.--"Influence of Electric Fields on Ultraviolet-Excited Phosphors" by Frank Matossi and Sol Nudelman, U. S. Naval Ordnance Lab., White Oak, Md.
(Abstract No. 30)

10:20 A.M.--"Dielectric Behavior of Electroluminescence" by Willi Lehmann, Westinghouse Electric Corp., Bloomfield, N. J.
(Abstract No. 31)

10:40 A.M.--"Electroluminescence of Zinc Sulfide Single Crystals" by D. R. Frankl, Physics Labs., Sylvania Electric Products Inc., Bayside, N. Y. (Abstract No. 32)

11:00 A.M.--"Effect of Electron Traps on Electroluminescence" by P. D. Johnson, W. W. Piper, and F. E. Williams, Research Lab., General Electric Co., Schenectady, N. Y. (Abstract No. 33)

11:15 A.M.--"Infrared Quenching of Cadmium Sulfide Photoconductivity" by S. H. Liebson, U. S. Naval Research Lab., Washington, D. C. (Abstract No. 34)

11:35 A.M.--"Recombination Processes in Cadmium Sulfide" by John Lambe, U. S. Naval Research Lab., Washington, D. C.
(Abstract No. 35)

12:30 P.M.--Society Luncheon and Annual Business Meeting in the Roof Garden.

ELECTRONICS--LUMINESCENCE

Tuesday, May 3, 1955

with F. E. Williams presiding

(Victory Room, Lower Lobby)

2:00 P.M.--"Sensitized Luminescence in NaCl: Ag + Cu" by E. W. Claffy and C. C. Klick,

U. S. Naval Research Lab., Washington, D. C. (Abstract No. 36)

2:20 P.M.--"Fluorescence of Thallium-Activated Halide Phosphors, I. Spectra of NH_4 Br:Tl" by K. H. Butler, Sylvania Electric Products Inc., Salem, Mass. (Abstract No. 37)

2:40 P.M.--"Fluorescence of Thallium-Activated Halide Phosphors, II. Spectra of KCl:Tl" by K. H. Butler, Sylvania Electric Products Inc., Salem, Mass. (Abstract No. 38)

3:00 P.M.--"Some General Considerations on the Preparation of Oxygen Dominated Phosphors" by J. L. Ouweltjes and W. L. Wanmaker, Phosphor Div., N. V. Philips' Gloeilampenfabrieken, Eindhoven, The Netherlands. (Abstract No. 39)

3:20 P.M.--"Activator Systems in Sulfide and Halophosphate Phosphors" by J. S. Prener and F. E. Williams, Research Lab., General Electric Co., Schenectady, N. Y. (Abstract No. 40)

3:40 P.M.--"Controlled Preparation and X-Ray Investigation of Cadmium Sulfide" by F. Schossberger, Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill. (Abstract No. 41)

4:00 P.M.--"Retention of Chloride in Fired Zinc Sulfide" by P. Goldberg, D. J. Bracco, and A. Kremheller, Chemistry Lab., Sylvania Electric Products Inc., Flushing, N. Y. (Abstract No. 42)

4:20 P.M.--"Particle Size and Structure of Fired Zinc Sulfide Powders" by A. Kremheller, P. Goldberg, and D. J. Bracco, Chemistry Lab., Sylvania Electric Products Inc., Flushing, N. Y. (Abstract No. 43)

4:40 P.M.--"The Oxidation of Zinc Sulfide Precipitates to Zinc Sulfate" by D. T. Palumbo and A. K. Levine, Chemistry Lab.,

Sylvania Electric Products Inc., Flushing, N. Y. (Abstract No. 44)

ELECTRONICS--LUMINESCENCE

Wednesday, May 4, 1955

Specific Phosphor Behavior

with K. H. Butler presiding

(Parlor 7, Mezzanine)

9:00 A.M.--"Lead and Manganese-Activated Cadmium Fluorophosphates" by R. W. Wollentin, Research Dept., Westinghouse Electric Corp., Bloomfield, N. J. (Abstract No. 45)

9:20 A.M.--"Calcium Halophosphate Phosphors, II. Optical Properties of the Particle Surface" by M. J. Bergin, K. H. Butler, and H. H. Homer, Sylvania Electric Products Inc., Salem, Mass. (Abstract No. 46)

9:40 A.M.--"A New Blue-Emitting Phosphor with Manganese Activator" by E. L. Lind, RCA Labs., Radio Corp. of America, Princeton, N. J. (Abstract No. 47)

10:00 A.M.--"Magnesium Fluosilicate Phosphors" by P. W. Ranby and S. T. Henderson, Thorn Electrical Industries, Ltd., London, England. (Abstract No. 48)

10:20 A.M.--"Preliminary Studies of the Perowskite-Type Ternary Oxides As Luminophors" by Salvador Terol and Roland Ward, Chemical Labs., University of Connecticut, Storrs, Conn. (Abstract No. 49)

10:40 A.M.--"Two Arsenate Phosphors and the Significance of Their Emission" by G. R. Fonda, General Electric Co., Cleveland, Ohio. (Abstract No. 50)

11:00 A.M.--"The System Cadmium Oxide-Boric Oxide" by E. C. Subbarao and F. A. Hummel, School of Mineral Industries, Dept. of Ceramics, Pennsylvania State University,

State College, Pa. (Abstract No. 51)

11:20 A.M.--"Luminescent Screens Made by Vapor Reaction" by D. A. Cusano and F. J. Studer, Research Lab., General Electric Co., Schenectady, N. Y. (Abstract No. 52)

11:40 A.M.--"Cathodoluminescent Lamps" by L. R. Koller, Research Lab., General Electric Co., Schenectady, N. Y. (Abstract No. 53)

12:00 M.--"Color Shifts in Zn-Cd-S (Ag) Phosphors" by Vanja Srepel, General Electric Co., Electronics Park, Syracuse, N. Y. (Abstract No. 54)

12:30 P.M.--Electronics Division Luncheon and Business Meeting. Room to be announced.

ELECTRONICS--LUMINESCENCE

Wednesday, May 4, 1955

Round Table

with Roland Ward presiding

(Parlor 7, Mezzanine)

2:00 P.M.--1. Continuation of discussion of papers presented at three previous sessions.

2. "Late News Items," ten minutes each.

3. General discussion.

ELECTRONICS--OXIDE CATHODES

Monday, May 2, 1955

with J. G. Buck presiding

(Parlor 7, Mezzanine)

2:00 P.M.--Introductory remarks by C. P. Hadley.

2:05 P.M.--Keynote Address--"Fundamental Phenomena of Thermionic Emission" by W. B.

Nottingham, Massachusetts Institute of Technology, Cambridge, Mass. (Abstract No. 55)

2:50 P.M.--"A New Sintered Tungsten Matrix Cathode" by E. A. Thurber, Bell Telephone Labs., Murray Hill, N. J. (Abstract No. 56)

3:20 P.M.--"Some Studies on Problems Associated with the Molded Nickel Cathode" by I. J. Bell and G. R. Brewer, Electron Tube Lab., Hughes Research and Development Labs., Culver City, Calif. (Abstract No. 57)

3:35 P.M.--"Some Applications of L Cathodes" by J. Babakian, A. Matthewson, and J. Bloom, Air Force Cambridge Research Center, Boston, Mass. (Abstract No. 58)

4:00 P.M.--"Manufacturing Advantages of the Philips Impregnated Cathode Used in Magnetron Applications" by Markus Nowogrodzki, Amperex Electronic Corp., Hicksville, N. Y. (Abstract No. 59)

4:15 P.M.--"Emission from Molybdenum Activated with Barium" by R. H. Ahlert and E. S. Rittner, Philips Labs., Irvington-on-Hudson, N. Y. (Abstract No. 60)

4:35 P.M.--"An Investigation of the Impregnated Cathode" by W. C. Rutledge, E. S. Rittner, and R. H. Ahlert, Philips Labs., Irvington-on-Hudson, N. Y. (Abstract No. 61)

ELECTRONICS--OXIDE CATHODES

Tuesday, May 3, 1955

with L. S. Nergaard presiding

(Parlor 7, Mezzanine)

9:30 A.M.--"Improved Philips 'Impregnated Cathode'" by Roberto Levi, Philips Labs., Irvington-on-Hudson, N. Y. (Abstract No. 62)

9:45 A.M.--"Chemical Processes in Thin-Film Dispenser Cathodes" by R. C. Hughes and P. P. Coppola, Philips Labs., Irvington-on-Hudson, N. Y. (Abstract No. 63)

10:05 A.M.--"A New Pressed Dispenser Cathode" by P. P. Coppola and R. C. Hughes, Philips Labs., Irvington-on-Hudson, N. Y. (Abstract No. 64)

10:35 A.M.--"Thermionic Emission Evaluation of Single Constituent Additives in Pure Nickel Cathodes" by F. T. Hill, Raytheon Manufacturing Co., Newton, Mass. (Abstract No. 65)

11:05 A.M.--"Application of Automatic Recording Instruments to the Measurement of Emission" by A. N. Yeaton and C. D. Richard, Jr., Superior Tube Co., Norristown, Pa. (Abstract No. 66)

11:30 A.M.--"A Simplified Gas Adsorption Method for the Determination of Surface Area of Fine Powders" by D. T. Palumbo, F. M. Starkweather, and D. J. Bracco, Chemistry Lab., Sylvania Electric Products Inc., Flushing, N. Y. (Abstract No. 67)

12:30 P.M.--Society Luncheon and Business Meeting in the Roof Garden.

ELECTRONICS--OXIDE CATHODES

Tuesday, May 3, 1955

with E. A. Coomes presiding

(Parlor 7, Mezzanine)

2:00 P.M.--"Electrical Properties of the Oxide Cathode Coating" by Ralph Forman, National Bureau of Standards, Washington, D. C. (Abstract No. 68)

2:30 P.M.--"Activation of an Oxide Cathode by Ba, Sr, Ca, and MgDeposited via a Mass Spectrometer" by R. M. Matheson and R. H. Plumlee, RCA Labs., Radio Corp. of America,

Princeton, N. J. (Abstract No. 69)

3:00 P.M.--"Mass Spectrometric Study of the Field Dependent Evolution of Constituents of a BaO Cathode" by R. H. Plumlee, RCA Labs., Radio Corp. of America, Princeton, N. J. (Abstract No. 70)

3:30 P.M.--"Factors Influencing the Particle Size in the Preparation of Alkaline Earth Carbonates" by D. T. Palumbo, D. J. Bracco, and A. K. Levine, Chemistry Lab., Sylvania Electric Products Inc., Flushing, N. Y. (Abstract No. 71)

4:00 P.M.--Round-table discussion.

ELECTRONICS--PHOSPHOR APPLICATION

Thursday, May 5, 1955

with Channing Dichter presiding

(Parlor 7, Mezzanine)

9:30 A.M.--Introductory remarks by Channing Dichter.

9:40 A.M.--"Particle Size Methods for TV Phosphors" by J. Rabatin, E. Palik, and R. Gale, Lamp Dept., General Electric Co., Cleveland, Ohio. (Abstract No. 72)

10:10 A.M.--"The Use of Polyvinyl Alcohol in the Preparation of Color Phosphor Screens" by The Staff, Parlin Labs., E. I. du Pont de Nemours and Co., Parlin, N. J. (Abstract No. 73)

10:45 A.M.--"Kelvin Method of Screen Potential Measurement and Screen Changing" by J. T. Young, Research Lab., General Electric Co., Schenectady, N. Y. (Abstract No. 74)

11:15 A.M.--"Ion Focusing Fields and Ion Deterioration Effects on Cathode Ray Tube Screens" by W. A. Thornton, Research Lab.,

General Electric Co., Schenectady, N. Y. (Abstract No. 75)

11:45 A.M.--"Secondary Electron Yields of Screen Materials" by A. B. Laponsky, Research Lab., General Electric Co., Schenectady, N. Y. (Abstract No. 76)

12:15 P.M.--Late News Papers.

ELECTRONICS--PHOSPHOR APPLICATION

Thursday, May 5, 1955

Round Table

with M. Sadowsky presiding

(Parlor 7, Mezzanine)

2:00 P.M.--Round-table discussion.

ELECTRONICS--SEMICONDUCTORS

Wednesday, May 4, 1955

Elemental Semiconductors

with N. B. Hannay presiding

(Victory Room, Lower Lobby)

9:00 A.M.--Introductory remarks by F. J. Biondi.

9:05 A.M.--"Properties of Germanium and Silicon" by E. M. Conwell, Sylvania Electric Products Inc., Bayside, N. Y. (Abstract No. 77)

9:30 A.M.--"Injection and Extraction" by Ralph Bray, Purdue University, Lafayette, Ind. (Abstract No. 78)

10:00 A.M.--"The Germanium-Oxygen System" by Donald Tuomi and E. S. Candidus, Lincoln Lab., Massachusetts Institute of Technology, Lexington, Mass. (Abstract No. 79)

10:30 A.M.--"Donor-Acceptor Balance in Selenium Rectifiers" by H. W. Henkels, Westinghouse Electric Corp., Pittsburgh, Pa. (Abstract No. 80)

11:00 A.M.--"Correlation of Electrical Properties of Selenium Rectifiers with Fundamental Bulk Properties" by H. W. Henkels, Westinghouse Electric Corp., Pittsburgh, Pa. (Abstract No. 81)

11:30 A.M.--Ten-minute papers of "late news" type. Titles and short abstracts will be available at the Registration Desk.

12:30 P.M.--Electronics Division Luncheon and Business Meeting. Room to be announced.

ELECTRONICS--SEMICONDUCTORS

Wednesday, May 4, 1955

Surface Controlled Phenomena

with J. E. Thomas presiding

(Victory Room, Lower Lobby)

2:00 P.M.--"Review of the State of Semiconductor Surfaces" by R. H. Kingston, Lincoln Lab., Massachusetts Institute of Technology, Lexington, Mass. (Abstract No. 82)

2:30 P.M.--"Ultrahigh Vacuum Studies on Germanium Surfaces" by F. G. Allen, Harvard University, Cambridge, Mass. (Abstract No. 83)

3:00 P.M.--"Theory of Surface-Barrier Electrodes" by W. E. Bradley, Philco Corp., Philadelphia, Pa. (Abstract No. 84)

3:30 P.M.--"Holes and Electrons in Germanium Electrodes" by C. G. B. Garrett and W. H. Brattain, Bell Telephone Labs., Murray Hill, N. J. (Abstract No. 85)

4:00 P.M.--"Effect of Surface Treatments in

Low Pressure Gas Atmospheres on Characteristics of Evaporated Surface-Barrier Rectifiers" by P. A. Hartig, Philco Corp., Philadelphia, Pa. (Abstract No. 86)

4:30 P.M.--"Effect of Water Vapor on Germanium and Silicon Junctions" by J. T. Law and P. S. Meigs, Bell Telephone Labs., Murray Hill, N. J. (Abstract No. 87)

5:00 P.M.--"Observations of Channel Formation on N- and P-Type Semiconductors" by R. N. Noyce, Philco Corp., Philadelphia, Pa. (Abstract No. 88)

5:30 P.M.--"Oxidation of Clean Surfaces of Germanium below 25°C" by Mino Green and J. A. Kafalas, Lincoln Labs., Massachusetts Institute of Technology, Lexington, Mass. (Abstract No. 89)

ELECTRONICS--SEMICONDUCTORS

Thursday, May 5, 1955

Process Technology

with F. J. Biondi presiding

(Victory Room, Lower Lobby)

9:00 A.M.--"Etches for Imperfections in Silicon and Germanium" by J. W. Faust, Jr., Westinghouse Electric Corp., East Pittsburgh, Pa. (Abstract No. 90)

9:30 A.M.--"Theory of Jet Etching; Electrolytic Etching of Semiconductors" by W. E. Bradley, Philco Corp., Philadelphia, Pa. (Abstract No. 91)

10:00 A.M.--"The Purification of Germanium; The Germanium Tetrachloride-Arsenic Trichloride System" by Mino Green and J. A. Kafalas, Lincoln Lab., Massachusetts Institute of Technology, Lexington, Mass. (Abstract No. 92)

10:30 A.M.--"New Method for Producing High

Purity Silicon" by Gustav Szekely, Sylvania Electric Products Inc., Flushing, N. Y. (Abstract No. 93)

11:00 A.M.--"Depth of Surface Damage Due to Abrasion on Germanium" by T. M. Buck and F. S. McKim, Bell Telephone Labs., Murray Hill, N. J. (Abstract No. 94)

11:30 A.M.--"Electrochemical Preparation of Germane" by Mino Green and P. H. Robinson, Lincoln Lab., Massachusetts Institute of Technology, Lexington, Mass. (Abstract No. 95)

12:00 M.--Ten-minute papers of "late news" type. Titles and short abstracts will be available at the Registration Desk.

12:30 P.M.--Semiconductor Group Luncheon and Business Meeting. Room to be announced.

ELECTRONICS--SEMICONDUCTORS

Thursday, May 5, 1955

Semiconducting Alloys and Compounds

with P. H. Keck presiding

(Victory Room, Lower Lobby)

2:00 P.M.--"The Present Status of Intermetallic Semiconductors" by R. G. Breckenridge, National Bureau of Standards, Washington, D. C. (Abstract No. 96)

2:30 P.M.--"Effect of Zone-Refining Variables on the Segregation of Impurities in InSb" by T. C. Harman, R. K. Willardson, H. L. Goering, and A. C. Beer, Battelle Memorial Institute, Columbus, Ohio. (Abstract No. 97)

3:00 P.M.--"Photoeffects in InSb" by S. W. Kurnick, A. E. Goldberg, G. M. Mitchell, and R. N. Zitter, Midway Labs., University of Chicago, Chicago, Ill. (Abstract No. 98)

3:30 P.M.--"Effect of Impurities on Photoconductive CdS, CdSe, and PbS" by W. B. Hugle, Baldwin Piano Co., Cincinnati, Ohio.
(Abstract No. 99)

4:00 P.M.--"Experiments on the Formation of Anode Films on InSb" by J. F. Dewald, Bell Telephone Labs., Murray Hill, N. J.
(Abstract No. 100)

4:30 P.M.--Ten-minute papers of a "late news" type. Titles and short abstracts will be available at the Registration Desk.

ELECTROTHERMICS AND METALLURGY

Monday, May 2, 1955

with H. S. Newhall presiding

(Parlors 8 and 9, Mezzanine)

9:15 A.M.--"Electric Smelting Furnaces" by M. J. Udy, Consulting Engineer, 546 Portage Rd., Niagara Falls, N. Y.
(Abstract No. 101)

9:45 A.M.--"The Use of Electric Furnaces by the Bureau of Mines in Ferroalloy Research" by N. B. Melcher, Ferrous Metals and Alloys Branch, U. S. Department of the Interior, Bureau of Mines, Washington, D. C.
(Abstract No. 102)

10:15 A.M.--"High Speed Electrohydraulic Arc Furnace Control" by W. Nordin, Aros Electric, Inc., New York, N. Y.
(Abstract No. 103)

10:45 A.M.--"The Trend in Electric Furnace Design Particularly As It Applies to the Production of Calcium Carbide" by J. C. Bode, National Carbide Co., New York, N. Y.
(Abstract No. 104)

(continued on next page)

ELECTROTHERMICS AND METALLURGY

Monday, May 2, 1955

with H. S. Newhall presiding

(Parlors 8 and 9, Mezzanine)

2:30 P.M.--"The Ferroalloy Industry in Australia" by R. H. Hooper, Ferroalloy Plant, Broken Hill Pty. Co. Ltd., Newcastle, N. S. W., Australia. (Abstract No. 105)

3:00 P.M.--"Materials Preparation for a Ferroalloy Operation" by D. E. Stingel, Alloy Works, Electro Metallurgical Co., Alloy, W. Va. (Abstract No. 106)

3:30 P.M.--"Materials Handling and Preparation of Raw Materials for Ferroalloy Furnaces" by R. A. Davidson, Vanadium Corp. of America, Niagara Falls, N. Y. (Abstract No. 107)

ELECTROTHERMICS AND METALLURGY

Tuesday, May 3, 1955

Oxidation and Corrosion

with A. A. Burr presiding

(Parlors 8 and 9, Mezzanine)

2:00 P.M.--"Thermodynamics of the Oxidation of Chromium" by J. N. Ramsey, D. Caplan, and A. A. Burr, Rensselaer Polytechnic Institute, Troy, N. Y. (Abstract No. 108)

2:30 P.M.--"High Temperature Oxidation of Two Zirconium-Tin Alloys" by M. W. Mallett and W. M. Albrecht, Battelle Memorial Institute, Columbus, Ohio. (Abstract No. 109)

3:00 P.M.--"Reaction of Nitrogen with Uranium" by M. W. Mallett and A. F. Gerds, Battelle Memorial Institute, Columbus, Ohio. (Abstract No. 110)

3:30 P.M.--"Oxide Nucleation and the Substruc-

ture of Metals" by E. A. Gulbransen, W. R. McMillan, and K. F. Andrew, Research Labs., Westinghouse Electric Corp., East Pittsburgh, Pa. (Abstract No. 111)

4:00 P.M.--"Erosion of Steel by Gases" by M. J. Fraser and A. A. Burr, Rensselaer Polytechnic Institute, Troy, N. Y. (Abstract No. 112)

4:30 P.M.--"Stress Corrosion Cracking in Magnesium" by D. K. Priest and M. G. Fontana, Ohio State University, Columbus, Ohio. (Abstract No. 113)

ELECTROTHERMICS AND METALLURGY

Wednesday, May 4, 1955

Electrochemical Techniques in Metallurgical Research

with J. H. Westbrook presiding

(Parlors 8 and 9, Mezzanine)

Thermodynamics

9:00 A.M.--"Electrochemical Techniques in Thermodynamics" by R. A. Oriani, Research Lab., General Electric Co., Schenectady, N. Y. (Abstract No. 114)

Mechanical Properties

9:30 A.M.--"Relations between Mechanical Deformation and Thermoelectric Force" by J. M. Berry, Research Lab., General Electric Co., Schenectady, N. Y. (Abstract No. 115)

Preparation of High Purity Metals

10:00 A.M.--"High Purity Manganese from Low-Grade Indian Ores" by A. Jogarao, Y. D. Prasada Rao, and S. Gopal, Central Electrochemical Research Institute, Karaikudi, India. (Abstract No. 116)

10:30 A.M.--"Melting and Deoxidizing with

Atomic Hydrogen" by P. C. Rossin, Research Lab., General Electric Co., Schenectady, N. Y. (Abstract No. 117)

11:00 A.M.--"Preliminary Investigation of Hafnium Metal by the Kroll Process" by H. L. Gilbert and M. M. Barr, U. S. Department of the Interior, Bureau of Mines, Albany, Oreg. (Abstract No. 118)

11:30 A.M.--"Bomb Reduction of Molybdenum Trioxide by Calcium Metal" by H. L. Gilbert and F. E. Block, U. S. Department of the Interior, Bureau of Mines, Albany, Oreg. (Abstract No. 119)

12:30 P.M.--Electrothermics and Metallurgy Division Luncheon and Business Meeting. Room to be announced.

ELECTROTHERMICS AND METALLURGY

Wednesday, May 4, 1955

Electrochemical Techniques in Metallurgical Research (cont'd)

with J. H. Westbrook presiding

(Parlors 8 and 9, Mezzanine)

Metallography

2:00 P.M.--"Electropolishing from the Viewpoint of Surface Metallurgy" by C. L. Faust, Battelle Memorial Institute, Columbus, Ohio. (Abstract No. 120)

2:30 P.M.--"Chemical Polishing of Metallographic Specimens" by H. W. Schadler and J. E. Burke, Research Lab., General Electric Co., Schenectady, N. Y. (Abstract No. 121)

3:00 P.M.--"Thermal Etching of Chromium" by M. J. Fraser, D. Caplan, and A. A. Burr, Rensselaer Polytechnic Institute, Troy, N. Y. (Abstract No. 122)

Atom Movements

3:30 P.M.--"Segregation Coefficient of Some Group III and Group V Elements in Gold" by E. B. Dale and W. L. Mefferd, Battelle Memorial Institute, Columbus, Ohio. (Abstract No. 123)

4:00 P.M.--"The Gray Tin Phenomenon: Additional Data" by R. R. Rogers and J. F. Fydell, Mines Branch, Department of Mines and Technical Surveys, Ottawa, Ont., Canada. (Abstract No. 124)

4:30 P.M.--"Voltammetry in Fused Salt Systems" by A. J. Kolk, M. E. Sibert, and M. A. Steinberg, Horizons Inc., Cleveland, Ohio. (Abstract No. 125)

INDUSTRIAL ELECTROLYTIC

Monday, May 2, 1955

with A. R. Orban presiding

(Victory Room, Lower Lobby)

9:15 A.M.--"A New Electrolytic Process for Brine Water by Using a Mercury Jet Cathode" by Shigeru Mizuno and Shinobu Toshima, Tokyo Institute of Technology, Tokyo, Japan. (Abstract No. 126)

9:45 A.M.--"Factors Affecting the Formation of Color in Caustic from Diaphragm Chlor-Alkali Cells" by R. E. Cushing, Engineering Dept., Wyandotte Works, Pennsylvania Salt Manufacturing Co., Wyandotte, Mich. (Abstract No. 127)

10:15 A.M.--"Technical Analysis of Diaphragm Cells for the Electrolysis of NaCl Solution" by Takashi Mukaibo, Dept. of Applied Chemistry, University of Tokyo, Tokyo, Japan. (Abstract No. 128)

10:45 A.M.--"Portable Analyzer for the Determination of Hydrogen and Chlorine in Chlor-Alkali Cell Gas" by R. E. Cushing and R. S.

Reichard, Engineering Dept., Wyandotte Works, Pennsylvania Salt Manufacturing Co., Wyandotte, Mich. (Abstract No. 129)

11:15 A.M.--"The de Nora Fluent Amalgam Cell" by Vittorio de Nora, Patrizio Gallone, and Giovanni Trisoglio, Impianti Elettrochimici, Milan, Italy. (Abstract No. 130)

11:45 A.M.--"The Influence of Impurities in the Electrolyte in Chlorine-Caustic Electrolysis by the Mercury Cell Process, V. Further Investigation of the Influence of Metals on Cathodic Current Efficiency" by Gösta Angel, Tage Lundén, Stig Dahlerus, and Rolf Brännland, Div. of Applied Electrochemistry, Royal Institute of Technology, Stockholm, Sweden. (Abstract No. 131)

12:30 P.M.--Industrial Electrolytic Division Luncheon. W. C. Gardiner will give the Chlor-Alkali Report.

INDUSTRIAL ELECTROLYTIC

Monday, May 2, 1955

Round Table

with A. R. Orban presiding

(Victory Room, Lower Lobby)

2:00-5:00 P.M.--Round-table discussion on rectifiers. The following companies will be represented: Westinghouse Electric Corp., selenium rectifiers; General Electric Co., germanium rectifiers; ITE, mechanical rectifiers; Allis Chalmers Mfg. Co., mercury arc rectifiers; and Pennsylvania Salt Mfg. Co., rotary converter rectifiers.

INDUSTRIAL ELECTROLYTIC

Tuesday, May 3, 1955

with Warren Sherrow presiding

(Ballroom, Lobby)

9:00 A.M.--"The Lithium Industry" by P. E. Landolt, Consulting Engineer, 36 West 44th St., New York, N. Y. (Abstract No. 132)

9:25 A.M.--"The Current Efficiency of Fluorine Cells" by J. Dykstra and G. H. Montillon, K-25 Plant, Carbide and Carbon Chemicals Co., Oak Ridge, Tenn. (Abstract No. 133)

9:50 A.M.--"Progress of Improvements in Materials of Construction of Fluorine Cells" by J. Dykstra and G. H. Montillon, K-25 Plant, Carbide and Carbon Chemicals Co., Oak Ridge, Tenn. (Abstract No. 134)

10:15 A.M.--"New Continuous Processes for Production of Beryllium Hydroxide and Beryllium Metal" by C. W. Schwenzfeier, Jr., Brush Beryllium Co., Cleveland, Ohio. (Abstract No. 135)

10:40 A.M.--"Electrochemical Preparation of Boron" by N. F. Murphy, R. S. Tinsley, and G. F. Meenaghan, Dept. of Chemical Engineering, Virginia Polytechnic Institute, Blacksburg, Va. (Abstract No. 136)

11:05 A.M.--"Electrolytic Crystal Growth of Titanium" by Q. H. McKenna, M. E. Sibert, and M. A. Steinberg, Horizons Inc., Cleveland, Ohio. (Abstract No. 137)

11:30 A.M.--"Electrodeposition of Titanium on Base Metals" by M. E. Sibert and M. A. Steinberg, Horizons Inc., Cleveland, Ohio. (Abstract No. 138)

12:30 P.M.--Society Luncheon and Annual Business Meeting in the Roof Garden.

Joint Session

THEORETICAL ELECTROCHEMISTRY

and

INDUSTRIAL ELECTROLYTIC

Wednesday, May 4, 1955

Fused Electrolytes

with W. J. Hamer presiding

(Foyer, Roof Garden)

2:00 P.M.--"Thermodynamics of Fused Electrolytes" by Carl Wagner, Dept. of Metallurgy, Massachusetts Institute of Technology, Cambridge, Mass. (Invited Paper) (Abstract No. 139)

2:30 P.M.--"Electrical Conductance and Ionic Migration in Molten Salts" by E. R. Van Artsdalen, I. S. Yaffe, and F. J. Miller, Chemistry Div., Oak Ridge National Lab., Oak Ridge, Tenn. (Abstract No. 140)

3:00 P.M.--"Electric Conductance, Transport, and Viscosity in Molten Systems with Special Reference to Molten Silicates and Borates" by J. O'M. Bockris and G. W. Mellors, Dept. of Chemistry, University of Pennsylvania, Philadelphia, Pa. (Invited Paper) (Abstract No. 141)

3:30 P.M.--"Transference Numbers of Cations and Anions in Fused Silver Nitrate and Silver Nitrate-Sodium Nitrate Mixtures" by F. R. Duke and Richard Laity, Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa. (Invited Paper) (Abstract No. 142)

4:00 P.M.--"Transport Numbers in Pure Fused Thallium (I) Chloride" by Richard Laity and F. R. Duke, Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa. (Abstract No. 143)

Joint Session

THEORETICAL ELECTROCHEMISTRY

and

INDUSTRIAL ELECTROLYTIC

Thursday, May 5, 1955

Fused Electrolytes

with R. Roberts presiding

(Foyer, Roof Garden)

9:00 A.M.--"Kinetics of Electrode Processes in Fused Salts" by Paul Delahay, Dept. of Chemistry, Louisiana State University, Baton Rouge, La. (Invited Paper) (Abstract No. 144)

9:30 A.M.--"Impedance Measurements at Solid Electrodes in Molten Lithium Chloride-Potassium Chloride" by H. A. Laitinen, Dept. of Chemistry and Chemical Engineering, University of Illinois, Urbana, Ill., and R. A. Osteryoung, Dept. of Chemistry, Rensselaer Polytechnic Institute, Troy, N. Y. (Invited Paper) (Abstract No. 145)

10:00 A.M.—"Purification of Lithium Chloride-Potassium Chloride Euctectic as a Polarographic Fused Salt Solvent" by H. A. Laitinen and W. S. Ferguson, Dept. of Chemistry and Chemical Engineering, University of Illinois, Urbana, Ill., and R. A. Osteryoung, Dept. of Chemistry, Rensselaer Polytechnic Institute, Troy, N. Y. (Abstract No. 146)

Round Table

10:30 A.M.—Round-table discussion on electrode potentials in fused electrolytes with Walter Hamer, H. A. Laitinen, and Seymour Senderoff.

Joint Session

THEORETICAL ELECTROCHEMISTRY

and

INDUSTRIAL ELECTROLYTIC

Thursday, May 5, 1955

with Allen Russell presiding

(Foyer, Roof Garden)

2:00 P.M.--"Galvanic Functions of Cells with Molten Salt Electrolytes, I. The Nominal System Mg| KCl-LiCl (l)|Ni" by S. M. Selis, G. R. B. Elliott, and L. P. McGinnis, Diamond Ordnance Fuze Labs., Washington, D. C. (Abstract No. 147)

2:25 P.M.--"Galvanic Functions of Cells with Molten Salt Electrolytes, II. The Nominal System Mg|KCl-LiCl-K_2CrO_4 (l)|Ni and the Effects of Added Solid Acidic Oxides" by S. M. Selis and L. P. McGinnis, Diamond Ordnance Fuze Labs., Washington, D. C. (Abstract No. 148)

2:50 P.M.--"Sodium-Aluminum Equilibria in Cryolite-Alumina Melts" by Morris Feinleib and Bernard Porter, Reduction Research Lab., Kaiser Aluminum and Chemical Corp., Permanente, Calif. (Abstract No. 149)

3:15 P.M.--"Electrochemical Characteristics of Melts in the Sb-Sb_2S_3 System" by Tsutomu Yanagase and G. Derge, Metals Research Lab., Carnegie Institute of Technology, Pittsburgh, Pa. (Abstract No. 150)

3:40 P.M.--"Liquidus Curves for Aluminum Cell Electrolytes, I. Cryolite-Alumina" by N. W. F. Phillips, R. H. Singleton, and E. A. Hollingshead, Aluminium Labs., Ltd., Arvida, Que., Canada. (Abstract No. 151)

4:05 P.M.--"Liquidus Curves for Aluminum Cell Electrolytes, II. Ternary Systems of Cryolite-Alumina with Aluminum Fluoride, Sodium

Fluoride, and Sodium Chloride" by N. W. F. Phillips, R. H. Singleton, and E. A. Hollingshead, Aluminium Labs., Ltd., Arvida, Que., Canada. (Abstract No. 152)

THEORETICAL ELECTROCHEMISTRY

Monday, May 2, 1955

with Ernest Yeager presiding

(Foyer, Roof Garden)

9:15 A.M.--"Concentration Polarization and Overvoltage" by C. V. King, Dept. of Chemistry, New York University, New York, N. Y. (Abstract No. 153)

9:40 A.M.--"Ion Distribution during Electrolysis" by H. P. Dengler and H. B. Linford, Dept. of Chemical Engineering, Columbia University, New York, N. Y. (Abstract No. 154)

10:05 A.M.--"Fundamental Thermodynamics and Kinetics of Electrode Processes" by Pierre Van Rysselberghe, Dept. of Chemistry, University of Oregon, Eugene, Oreg. (Abstract No. 155)

10:30 A.M.--"Some Applications of the Thermodynamics of Irreversible Electrochemical Processes" by Pierre Van Rysselberghe, Dept. of Chemistry, University of Oregon, Eugene, Oreg. (Abstract No. 156)

10:55 A.M.--"Elucidation of the True Mechanism of Hydrogen Evolution, I. Quantitative New Consecutive Theory on Smooth Platinum Electrode" by A. M. Azzam, Chemistry Dept., Faculty of Science, Ein-Shams University, Cairo, Egypt. (Abstract No. 157)

11:20 A.M.--"Mechanisms of Hydrogen Producing Reactions on Palladium" by J. P. Hoare and Sigmund Schuldiner, Naval Research Lab., Washington, D. C. (Abstract No. 158)

THEORETICAL ELECTROCHEMISTRY

Monday, May 2, 1955

with Paul Delahay presiding

(Foyer, Roof Garden)

2:00 P.M.--"Hydrogen Overpotential on Silver Single Crystals" by H. B. Morley and F. E. W. Wetmore, Electrochemical Lab., University of Toronto, Toronto, Ont., Canada.
(Abstract No. 159)

2:25 P.M.--"Hydrogen Overpotential Studies on Aluminum" by D. J. Hansen and F. E. W. Wetmore, Electrochemical Lab., University of Toronto, Toronto, Ont., Canada.
(Abstract No. 160)

2:50 P.M.--"Calculation of the Effect of Cationic Specific Adsorption on the Proton Discharge Rates at Mercury and Other Cathodes" by B. E. Conway, J. O'M. Bockris, and B. Lovrocek, Dept. of Chemistry, University of Pennsylvania, Philadelphia, Pa.
(Abstract No. 161)

3:15 P.M.--"The Influence of Adsorption from Double Layer Capacitance Measurements" by B. H. Clampitt and R. S. Hansen, Ames Lab., U. S. Atomic Energy Commission, Ames, Iowa.
(Abstract No. 162)

3:40 P.M.--"The Kinetics of the Oxygen Electrode on Active Carbon" by Myron Davies, Milton Clark, Ernest Yeager, and Frank Hovorka, Dept. of Chemistry, Western Reserve University, Cleveland, Ohio.
(Abstract No. 163)

4:05 P.M.--"Dissolution of Metals in Acids, III. Kinetics" by A. C. Makrides, Institute for the Study of Metals, University of Chicago, Chicago, Ill.
(Abstract No. 164)

4:30 P.M.--"Anodic Polarization of Titanium in Nonaqueous Base Etching Solutions" by Morris Eisenberg and R. E. De La Rue,

Stanford Research Institute, Stanford, Calif. (Abstract No. 165)

THEORETICAL ELECTROCHEMISTRY

Tuesday, May 3, 1955

with Ernest Yeager presiding

(Foyer, Roof Garden)

9:00 A.M.--"Oxide Film Formation on the Surface of Metals in Aqueous Solutions and the Evaluation of Their Standard Potentials, III. The Lead Electrode" by S. E. S. El Wakkad and T. M. Salem, University of Pennsylvania, Philadelphia, Pa., and Cairo University, Cairo, Egypt. (Abstract No. 166)

9:25 A.M.--"Anodic Oxidation of Zinc and Zinc-Tin Alloys at Very Low Current Density" by S. E. S. El Wakkad, A. M. Shams Eldin, and H. Kotb, University of Pennsylvania, Philadelphia, Pa., and Cairo University, Cairo, Egypt. (Abstract No. 167)

9:50 A.M.--"Anodic Oxidation of Metal Ions to Insoluble Higher Oxides with Special Reference to Manganese Dioxide" by H. K. Chakrabarti and T. Banerjee, National Metallurgical Lab., Council of Scientific and Industrial Research, Jamshedpur, India. (Abstract No. 168)

10:15 A.M.--"The Kinetics of Formation of Anodic Ta_2O_5: Further Studies" by D. A. Vermilyea, Metallurgy Research Dept., Research Lab., General Electric Co., Schenectady, N. Y. (Abstract No. 169)

10:40 A.M.--"Mathematical Studies of Galvanic Corrosion, II. Coplanar Electrodes with One Electrode Infinitely Large and with Equal Polarization Parameters" by J. T. Waber and Marshall Rosenbluth, University of California, Los Alamos Scientific Lab., Los Alamos, N. Mex. (Abstract No. 170)

11:05 A.M.—"Mathematical Studies of Galvanic Corrosion, III. Semi-Infinite Coplanar Electrodes with Equal Constant Polarization Parameters" by J. T. Waber, University of California, Los Alamos Scientific Lab., Los Alamos, N. Mex. (Abstract No. 171)

11:30 A.M.—Theoretical Electrochemistry Division Business Meeting.

12:30 P.M.—Society Luncheon and Annual Business Meeting in the Roof Garden.

THEORETICAL ELECTROCHEMISTRY

Tuesday, May 3, 1955

with Ralph Roberts presiding

(Foyer, Roof Garden)

2:00 P.M.—"Mathematical Studies on Galvanic Corrosion, IV. Influence of Electrolyte Thickness on the Potential and Current Distributions over Coplanar Electrodes Using Polarization Parameters" by J. T. Waber and Bertha Fagan, University of California, Los Alamos Scientific Lab., Los Alamos, N. Mex. (Abstract No. 172)

2:25 P.M.—"Polar Properties of Solvent and the Conductance of Electrolytes at Infinite Dilution" by E. S. Amis, Dept. of Chemistry, University of Arkansas, Fayetteville, Ark. (Abstract No. 173)

2:50 P.M.—"The Heat of Hydration of Metallic Ions" by A. L. Bisio, Dept. of Chemical Engineering, Columbia University, New York, N. Y. (Abstract No. 174)

3:15 P.M.—"Conductances, Viscosities, and Densities of Solutions of Potassium Thiocyanate in Methanol at Temperatures within the Range 25°-50°C" by P. G. Sears, R. R. Holmes, and L. R. Dawson, Dept. of Chemistry, University of Kentucky, Lexington, Ky. (Abstract No. 175)

3:40 P.M.--"The Conductance of Lithium Bromide at Low Concentrations in Methanol within the Temperature Range 20° to -50°C" by P. G. Sears, R. L. McNeer, and L. R. Dawson, Dept. of Chemistry, University of Kentucky, Lexington, Ky.
(Abstract No. 176)

4:05 P.M.--"Conductimetric and Viscometric Behavior of Lithium Bromide in 50-50 Weight Per Cent Methanol-Acetone at Temperatures within the Range 20° to -50°C" by L. R. Dawson, R. A. Hagstrom, and P. G. Sears, Dept. of Chemistry, University of Kentucky, Lexington, Ky.
(Abstract No. 177)

4:30 P.M.--"Conductances of Some Moderately Concentrated Solutions of Metallic Perchlorates in the Mixed Solvent Methanol-Acetone at Low Temperatures" by P. G. Sears, W. W. Wharton, and L. R. Dawson, Dept. of Chemistry, University of Kentucky, Lexington, Ky. (Abstract No. 178)

THEORETICAL ELECTROCHEMISTRY

Wednesday, May 4, 1955

with C. V. King presiding

(Foyer, Roof Garden)

9:00 A.M.--"Electrolytes of Binary Solutes in Ketones" by J. E. Lilienfeld, H. Y. Hsiao, and H. S. Myers, Power Condenser and Electronics Corp., Washington, D. C.
(Abstract No. 179)

9:25 A.M.--"The Electrochemistry of Some Nonaqueous Solutions of Inorganic Salts" by M. C. Henry, W. M. McNabb, and J. F. Hazel, Dept. of Chemistry, University of Pennsylvania, Philadelphia, Pa.
(Abstract No. 180)

9:50 A.M.--"Conductivities of Random Dispersions" by R. E. De La Rue and C. W. Tobias,

Dept. of Chemistry and Chemical Engineering, University of California, Berkeley, Calif. (Abstract No. 181)

10:15 A.M.--"Quantitative Measurements of Colloidal Vibration Potentials" by Ernest Yeager, Joseph Dereska, and Frank Hovorka, Dept. of Chemistry, Western Reserve University, Cleveland, Ohio.
(Abstract No. 182)

10:40 A.M.--"Electrokinetic Potentials of Bulk Metals from Streaming Currents" by R. M. Hurd and Norman Hackerman, Defense Research Lab. and Dept. of Chemistry, University of Texas, Austin, Texas.
(Abstract No. 183)

11:05 A.M.--"High Pressure Oxidation of Metals; Oxidation of Metals under Conditions of a Linear Temperature Increase" by J. P. Baur, D. W. Bridges, and W. M. Fassell, Jr., Dept. of Metallurgy, University of Utah, Salt Lake City, Utah.
(Abstract No. 184)

ABSTRACTS

ELECTRIC INSULATION

Abstract No. 1

THE MEASUREMENT OF RADIATION AFFECTING INSULATION

W. W. Managan

The increasing interest of insulation specialists in the effects of radiation, both as a means of preparing new and improved products and as a deleterious condition for time-honored items, emphasizes the importance of accurate measurement of these radiational fields. Recent developments in counters and dosimeters as well as the effects of radiation upon the instruments used as detectors will be discussed.

Abstract No. 2

ELECTRON IRRADIATED POLYETHYLENE

J. R. Stirrat and P. A. Goodwin

The irradiation of polyethylene to electron bombardment results in a new, improved item suited for electrical insulation applications. The physical, mechanical, and electrical properties of this material are presented. The amount of crosslinking is dependent on the time of exposure, and the melting point may be raised without affecting the desirable qualities of flexibility or toughness.

Abstract No. 3

RADIOACTIVE ISOTOPES IN THE STUDY OF DIELECTRIC DEGRADATION

H. C. Beachell and V. L. Turner

Organic polymers used as dielectrics suffer changes in physical and electrical properties on aging. Chemical changes take place involving a series of reactions such as oxidation, chain scission, and cross-linking. The preparation of a radioactively labelled polyvinyl formal was undertaken in order to study the stability of one part of the formal structure to oxidative degradation. Radioactive formaldehyde has been synthesized into a polyvinyl formal polymer and subjected to oxidative aging. The results of this study will be presented.

Abstract No. 4

SYNTHESIS OF ELECTRICAL INSULATION BY MEANS OF GAMMA RADIATION

T. D. Callinan

Energetic radiation from radioactive isotopes has been employed successfully to polymerize monomers without the use of elevated temperatures or catalysts. This technique has been used to synthesize a variety of substances having desirable dielectric properties, e.g., polyethylene, polystyrene, polysilicone elastomers, and copolymers or acrylonitrile, and methyl acrylate. These polymers differ in physical characteristics from conventionally prepared analogous resins. The cobalt-60 source at NRL, techniques of synthesis, and properties of the polymers will be described.

Abstract No. 5

PROPERTIES OF GAFITE

H. D. Anspon

Chemical, physical, and electrical properties of "Gafite" are presented and reviewed. Present applications and possible future applications for Gafite suggested by

these physical properties are discussed.

Abstract No. 6

CASTING RESINS FOR THE ELECTRICAL TRADE

W. E. Harvey

Chemical, physical, and electrical properties of proprietary casting resins are discussed, with emphasis on the techniques for successful encapsulation and the applications where their use has been successful.

Abstract No. 7

PROPERTIES OF POLYAMIDE-EPOXY RESIN CASTING COMPOSITIONS

Wm. Minarik

New polyamide-epoxy resin blends have been found to have an affinity for glass fiber in either sheet or fiber form, resulting in better bonding and fewer voids. Properties of the resin itself are found to be superior to conventional thermosetting ones. Laboratory studies have shown superior impact strength and water resistance. These, and other characteristics, will be discussed quantitatively.

Abstract No. 8

SEMICERAMICS

M. D. Heyman

This new type of material fills the gap between soft flexible mica and rigid ceramics. Essentially, semiceramics are sheets of high temperature phlogopite mica that contain no organic materials. The useful temperature range is up to 1400°C. Considerable variation in the micas is permissible and a mix-

ture of synthetic and natural mica is used where low gassing qualities are imperative. Machining and stamping of parts are easily done.

Abstract No. 9

INORGANIC AND ORGANIC SYNTHETIC FIBER PAPERS FOR REINFORCED PLASTIC LAMINATES

H. F. Arledter

Mechanical, electrical, and chemical properties of inorganic and organic synthetic fiber papers of interest for impregnation and lamination are discussed. Among the papers evaluated are strand reinforced all-glass papers made of inorganic fibers in a thickness of 0.5-0.3 micron, as well as 5-10 micron. Other pilot plant paper materials described are made of polyfluoroethylene, tri-acetate, orlon, dacron, nylon, metal, etc., and mixtures of inorganic and organic synthetic fibers.

Abstract No. 10

THE MANUFACTURE AND PROPERTIES OF A NOVEL REINFORCED PLASTIC

J. W. Case and J. D. Robinson

A method of producing a parallel-type reinforcing glass fiber for plastics is described and laminates prepared from the basic material are compared with those made from conventional reinforcement.

Abstract No. 11

EPOXY RESIN GLASS BASE LAMINATES

J. C. Pitzer

Test data on laminates prepared from glass

fiber products and epoxy resins have revealed interesting fundamental information on the bonding mechanism. The tensile strength and flexure modulus have been determined as well as dielectric losses and dielectric strength.

Abstract No. 12

THE ELECTRICAL RESISTIVITY OF BONDED MICACEOUS MATERIALS AT ELEVATED TEMPERATURES

Kenneth Wechsler

Standard test methods for determining the quality of bonded micaceous materials are singularly lacking, as are specifications prescribing acceptable quality levels of the material per se. A method is presented for the determination of volume and surface resistivities measured at the temperatures related to end use, which, it is intended, will provide a convenient means of distinguishing between quality levels for acceptance test and manufacturing control purposes.

Abstract No. 13

THE PROPERTIES OF EXON

J. R. Bukey

Chemical, mechanical, and electrical properties of Exon are discussed and the application of these plastics to the electrical trade in the form of tapes, films, and extruded items is developed.

Abstract No. 14

THE ELECTRICAL CONDUCTIVITY OF CARBON BLACK REINFORCED ELASTOMERS

Gerard Kraus and J. F. Svetlik

The electrical conductivity of carbon black reinforced elastomers at fixed black loading is a function of particle size and aggregation habit, intrinsic conductivity, and ability of the carbon black to adsorb ionic impurities. These factors vary greatly in importance depending on filler concentration. The mechanism of conduction is primarily one of carbon black chain formation, a single path being capable of substantially lowering the resistivity of a rubber test slab. The above relations are illustrated with data on nine blacks in GR-S, Hevea, and butyl rubbers.

Abstract No. 15

HEAT STABILITY OF THE RESOLE TYPE PHENOL-FORMALDEHYDE RESINS

A. H. Haroldson

The heat stability of the resole type phenol-formaldehyde resins was studied by measuring changes in weight and dielectric loss properties measured at 60 cycles and 1 megacycle of samples which were heated at 130°C for various periods of time. Results show that alkyl substitution on the benzene ring decreases the resistance of the resin to oxidation and decreases the dielectric constant and dissipation factor.

Abstract No. 16

THE PAST, PRESENT, AND FUTURE OF PREFABRICATED WIRING (Printed Circuits)

Carl Coy

The author will begin with the original "start" and trace the development of the many processes which have stemmed from printed circuits. All important advances in the art will be discussed and the people responsible for them will be cited.

Abstract No. 17

ORGANIC PEROXIDES AS SOURCE OF CATIONS

Andrew Gemant

It has been found that aromatic hydrocarbons in the presence of small amounts of aliphatic acids on ozonization produce very high conductivities. This finding is significant because both aromatics and aliphatic acids may be present in small concentrations in insulating oils. By a detailed study of the effect observed, using ultraviolet absorption spectroscopy and measurement of paramagnetic susceptibility, among others, an attempt was made to establish the chemical nature of the ions causing the high electrical conductivity.

Abstract No. 18

RECENT DEVELOPMENTS IN POWER AND ALLIED PRODUCTS

N. R. Maleady

Commercially significant advances have been made in the design, fabrication, and production of power transformers, reactors, regulators, and capacitors. These improvements have been the result of intense adaptation of new materials and processes. The items produced yield increased reliability under service conditions and result in space and weight savings.

Abstract No. 19

RECENT DEVELOPMENTS IN ELECTRICAL MEASUREMENTS

J. A. Connor

The broad field of electrical measurements as a tool of science is usually com-

partmented into highly specialized and efficient adaptations. Few opportunities are available to scan the field for common philosophies, principles, or techniques. This paper takes such an opportunity to evaluate the common ground existing between contemporary methods normally considered as highly specialized developments in electrical measurements.

Abstract No. 20

DIELECTRIC PROPERTIES OF AEROSOLS

H. C. Thacher, Jr.

Recent developments of differential microwave refractometers have made it possible to measure dielectric constants with sufficient precision to detect the presence of aerosol concentrations below 20 mg/m^3. Aside from the value of this technique in characterizing aerosols, the results are also of theoretical interest, since they confirm the mixture law for one of the simplest colloid systems. More recent theoretical studies of losses and field effects in colloids will also be reviewed.

Abstract No. 21

EFFECTS OF MOISTURE, TEMPERATURE, AND FREQUENCY ON THE ELECTRICAL PROPERTIES OF INSULATING MATERIALS

L. J. Frisco

Further studies have been made of the effects of moisture absorption, temperature, and frequency on the electrical properties of insulating materials. Recent results and new breakdown techniques will be discussed.

Abstract No. 22

BREAKDOWN PHENOMENA AS RELATED TO OTHER DIELECTRIC PROPERTIES

J. J. Chapman

The author reports further progress in an extensive program. As the result of measurements of breakdown strength, dielectric constant, and dissipation factor over a wide range of frequency, the interdependence of these properties has been explored.

Abstract No. 23

INHIBITING EFFECTS OF 2,6-DI-TERTIARY-BUTYL PARA CRESOL ON CELLULOSE INSULATION DETERIORATION

E. D. Andrews and F. C. Doble

DBPC is being used increasingly as an inhibitor in mineral oil in transformers and cables. Recently it was found that DBPC has an inhibiting effect on the degradation of cellulose insulation. Data establishing this principle are presented.

Abstract No. 24

LIQUID FILLED CAPACITORS

Sydney Wald

Development and manufacturing techniques for liquid filled capacitors are discussed, as well as results of tests and recommendations on their uses. Increasing interest in miniaturization suggests the use of liquid dielectrics in variable condensers.

Abstract No. 25

RECENT DEVELOPMENTS IN ELECTROLYTIC CAPACITORS

Judson West, Jr.

The well-known limitations of electrolytic capacitors are being attacked systematically and advances have been made in increasing the thermal stability, temperature rating, and temperature de-rating characteristics of these items. Patents have been issued on new separators, oxidizing techniques, and electrolyte mixtures. These suggestions will be evaluated critically.

Abstract No. 26

HIGH VOLTAGE GLASS CAPACITORS

Gail Smith

Thin films of glass and metal may be sealed together at high temperature and pressure to form an integral, self-supporting capacitor. Pertinent dielectric properties of the glass will be presented. The electrical performance of these capacitors will be discussed, with advantages resulting from the unique method of formation.

Abstract No. 27

SUBMINIATURE CAPACITORS AND OTHER COMPONENTS

Louis Kahn

The demand for increased reliability, thermal stability, and weight savings is being met by subminiaturizing components. Capacitors have been developed having dimensions comparable with transistors. The qualities of such components and the problems associated with their development will be discussed.

Abstract No. 28

CAPACITORS FOR HIGH TEMPERATURE PULSE-FORMING NETWORKS

William Allison

The choice of dielectrics to be employed at high temperatures in pulse applications is discussed. Design considerations involved in high voltage capacitors for pulse network applications at high temperatures and also at low temperatures are given. A description of the capacitor resulting from this work to meet the requirements set up for a particular use, together with the test results obtained to date, is given.

ELECTRONICS--LUMINESCENCE

Abstract No. 29

THE THEORETICAL BASIS FOR PHOTOLUMINESCENCE, ELECTROLUMINESCENCE, AND PHOTOELECTRO-LUMINESCENCE

F. E. Williams

Luminescent emission of phosphors is determined by activator systems. In photoluminescence, excitation is also characteristic of the activator. Properties of representative activator systems are discussed. In electroluminescence, several mechanisms of excitation are feasible. In the case of electroluminescent ZnS:Cu, charge carriers are formed by field ionization and are accelerated to velocities sufficient for excitation of the activators by inelastic collisions. Photoelectroluminescence (radiation-induced electroluminescence) is emphasized as the basis for light amplifying phosphors.

Abstract No. 30

INFLUENCE OF ELECTRIC FIELDS ON ULTRAVIOLET-EXCITED PHOSPHORS

Frank Matossi and Sol Nudelman

Quantitative data on stimulation and quenching of ultraviolet-excited luminescence by electric fields will be presented. The transition from quenching ripple pattern to electroluminescence brightness waves will be shown for sinusoidal and square wave fields. These transition curves demonstrate that quenching and electroluminescence patterns have independent origins. Some of the phenomena will be interpreted as being due to polarization effects.

Abstract No. 31

DIELECTRIC BEHAVIOR OF ELECTROLUMINESCENCE

Willi Lehmann

Measurements are made concerning the complex dielectric constant of several electroluminescent zinc sulfides. Both the real and the imaginary part of the dielectric constant increase with increasing voltage and decreasing frequency. An empirical relationship is found relating the electroluminescent brightness, the applied frequency, and the dielectric constant. For the imaginary part of the dielectric constant this relationship can be explained theoretically.

Abstract No. 32

ELECTROLUMINESCENCE OF ZINC SULFIDE SINGLE CRYSTALS

D. R. Frankl

Application of half-wave sinusoidal

voltage pulses to certain crystals of zinc sulfide results in light emission having peaks at the maximum and near the end of the pulse. The first peak height is a nearly exponential function of the voltage, as is the current passing through the crystal. The second peak is the larger at low voltage amplitudes, but increases less rapidly with increasing voltage. The intensity of the first peak at field strengths near breakdown is of the order of 10^{12} quanta/sec.

Abstract No. 33

EFFECT OF ELECTRON TRAPS ON ELECTROLUMINESCENCE

P. D. Johnson, W. W. Piper, and F. E. Williams

A close interrelation between thermoluminescence and the temperature dependence of electroluminescence has been discovered. Electroluminescent brightness can be affected adversely at certain temperatures by electron traps. Conduction electrons arising from the ionization of activators in the region of electroluminescent excitation can be trapped so that the probability of their return to the activators is reduced. The variation with frequency of excitation of the temperature dependence of brightness is quantitatively accounted for by the theory.

Abstract No. 34

INFRARED QUENCHING OF CADMIUM SULFIDE PHOTOCONDUCTIVITY

S. H. Liebson

The literature contains little information on the infrared quenching characteristics of cadmium sulfide photoconductivity. Measurements have been made of the voltage and temperature dependence of proportional

change in photoconductivity due to infrared, and the variation of quenching with photoconductive light and infrared as variables. An interpretation is offered based on recombination of free holes with trapped electrons.

Abstract No. 35

RECOMBINATION PROCESSES IN CADMIUM SULFIDE

John Lambe

An experimental study has been carried out on the photoconductivity and luminescence of cadmium sulfide. The two main properties investigated were the photoconductive spectral response, and the relationship between luminescence and photoconductivity. It is found that the observed spectral response can be explained in terms of the dependence of lifetime of conduction electrons on the wave length of exciting light. The rise and decay of photoconductivity and luminescence have been examined for silver-activated CdS, and for the red and green luminescence of unactivated CdS. Decay of luminescence is much more rapid than decay of photoconductivity. An explanation for this behavior is offered.

Abstract No. 36

SENSITIZED LUMINESCENCE IN NaCl:Ag + Cu

E. W. Claffy and C. C. Klick

An investigation has been made to determine whether, as predicted by Dexter,* sensitized luminescence occurs in inorganic phosphors when both activator and sensitizer have allowed transitions. Efficiency measurements on NaCl:Ag + Cu as a function of activator concentration give reasonable agreement with theory. Computations on the

* D. L. Dexter, J. Chem. Phys., 21, 836 (1953).

"cascade" process indicate that the contribution of this mechanism to the observed effects is small.

Abstract No. 37

FLUORESCENCE OF THALLIUM-ACTIVATED HALIDE PHOSPHORS
I. Spectra of NH_4Br:Tl

K. H. Butler

Measurements of the excitation and emission spectra of thallium-activated ammonium bromide show two emission bands at 400 and 535 millimicrons. The shorter wave-length emission is excited by either 227 or 258 millimicron radiation, while the longer wave-length emission is excited by either 242 or 280 millimicron radiation. The origin of these bands in terms of electronic transitions in the activator ion is discussed.

Abstract No. 38

FLUORESCENCE OF THALLIUM-ACTIVATED HALIDE PHOSPHORS
II. Spectra of KCl:Tl

K. H. Butler

New measurements of the excitation and emission spectra of thallium-activated potassium chloride show that the broad excitation band at 240 to 270 millimicrons is a complex band with two components peaking at 245 and 260 millimicrons. Excitation in the 245 band leads to emission predominantly in a band peaking at 302 millimicrons, while excitation in the 260 band leads to a 492 millimicron band. Modifications in previously proposed electronic transitions in the activator ion are discussed in the light of these new data.

Abstract No. 39

SOME GENERAL CONSIDERATIONS ON THE PREPARATION OF OXYGEN DOMINATED PHOSPHORS

J. L. Ouweltjes and W. L. Wanmaker

Some applications are given of the fundamental principles of solid-state reactions. Very often the highest efficiency of a phosphor is obtained with a nonstoichiometrical composition. This must be considered as a consequence of the reactions involved in the synthesis of the phosphor. The course of these reactions is determined by the reactivities of the ingredients. In general, a high reactivity is desirable, but exceptions have been found. The connection between the particle size of the phosphor and that of the ingredients is discussed briefly.

Abstract No. 40

ACTIVATOR SYSTEMS IN SULFIDE AND HALOPHOSPHATE PHOSPHORS

J. S. Prener and F. E. Williams

Theoretical studies of luminescence emphasize the importance of local surroundings of activators. In ZnS:Cu, experiments using radioactive zinc indicate that the activator experiences the influence of the coactivator in a manner suggesting a nonrandom distribution without favoring nearest neighbors. In halophosphates, Sb^{+++} substitutes for the Ca^{++} site having a halide neighbor, and $O^{=}$ substitutes for that halide. Charge compensation is achieved locally. The independence of Sb emission on F^{-}/Cl^{-} is understandable. Halide content less than halophosphate stoichiometry is predicted.

Abstract No. 41

CONTROLLED PREPARATION AND X-RAY INVESTIGATION OF CADMIUM SULFIDE

F. Schossberger

A furnace for the controlled preparation of cadmium sulfide (CdS) by the vapor phase method is described. A constant rate of evaporation of the cadmium metal is maintained so that any changes in the ratio of Cd to S, or in the speed of reaction, can be made. Inserts fitted into the reaction tube allow the quick removal of the formed CdS without cooling the furnace. By the controlled operation of the reaction furnace, uniform crystal habits are obtained. X-ray diffraction analysis showed stacking faults to be present in CdS and CdSe crystals.

Abstract No. 42

RETENTION OF CHLORIDE IN FIRED ZINC SULFIDE

P. Goldberg, D. J. Bracco, and A. Kremheller

Chloride is determined in zinc sulfide by a concentration cell procedure based on Furman and Low.* Amounts of 0.001% by weight of chloride in 1 g of zinc sulfide can be determined quantitatively. Powder samples of zinc sulfide with coprecipitated chloride and with chloride added were fired in open boats and sealed vials with variation in firing times and temperatures. Results show that zinc sulfide fired with chloride goes through stages in firing during which the chloride content of the lattice varies. The implications of the data in respect to the action of fluxes will be discussed.

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* Furman and Low, J. Am. Chem. Soc., 57, 1585 (1935).

Abstract No. 43

PARTICLE SIZE AND STRUCTURE OF FIRED ZINC SULFIDE POWDERS

A. Kremheller, P. Goldberg, and D. J. Bracco

The influence of time and temperature of firing and the effect of various fluxes on particle size, crystal structure, and luminescence of zinc sulfide powder are reported. Particle size is measured by gas adsorption and by microscopic observation. An interpretation of the data will be given which correlates various aspects of the heat treatment and treats the implications in respect to the action of fluxes. The cubic hexagonal transition is influenced not only by halide but by associated cations and by oxide as well.

Abstract No. 44

THE OXIDATION OF ZINC SULFIDE PRECIPITATES TO ZINC SULFATE

D. T. Palumbo and A. K. Levine

Data are presented to show that ZnS digested with water in the presence of air is converted to $ZnSO_4$. The extent of reaction is negligible for times of digestion less than 48 hr at 70°C. The rate increases with increased specific surface of the sample and increased temperature.

Abstract No. 45

LEAD AND MANGANESE-ACTIVATED CADMIUM FLUOROPHOSPHATES

R. W. Wollentin

The sensitization of cadmium fluorophosphate activated by manganese to 2537 A ultra-

violet can be accomplished by additions of lead. A double emission band is obtained displaying a blue band peaked at about 4600 A and an orange band peaked at about 5900 A. Relative heights of peaks are influenced by the concentration of activators. Low lead and manganese content produces predominantly blue emission, while higher concentrations yield yellow to orange emission. The emission characteristics are altered by the presence of other foreign ions, for example, sodium, potassium, magnesium, and zinc.

Abstract No. 46

CALCIUM HALOPHOSPHATE PHOSPHORS II. Optical Properties of the Particle Surface

M. J. Bergin, K. H. Butler, and H. H. Homer

Measurements of reflectance, emission, and excitation spectra show that the optical properties of the particle surface are different from those of the body of the phosphor. Modification of this surface layer leads to improved phosphor brightness and also to improved stability of the phosphor during burning of fluorescent lamps.

Abstract No. 47

A NEW BLUE-EMITTING PHOSPHOR WITH MANGANESE ACTIVATOR

E. L. Lind

A research program designed to obtain a blue emission from luminescent materials with manganese activator has shown $CaBeF_4$:Mn to be such a material. This is the first fluorine dominated phosphor with manganese activator having a blue emission which is attributable to the manganese activator. This phosphor

has an exponential decay time of 60 millisec. A qualitative correlation exists between the peak wave length of the emission band and the Ca-F distance in CaF_2, $CaBeF_4$, and solid solutions of CaF_2 and SrF_2 with manganese activator.

Abstract No. 48

MAGNESIUM FLUOSILICATE PHOSPHORS

P. W. Ranby and S. T. Henderson

A description is given of the preparation of phosphors with a matrix of magnesium, silicon, oxygen, and fluorine, and activated by titanium or titanium and manganese. X-ray data show that a new structure is involved. The materials when excited by mercury resonance radiation have wide emission bands with a high proportion in the long wavelength region of the spectrum, and are useful fluorescent lamp phosphors. The mechanism of luminescence appears to be sensitization by titanium, although there are unusual features in the case.

Abstract No. 49

PRELIMINARY STUDIES OF THE PEROWSKITE-TYPE TERNARY OXIDES AS LUMINOPHORS

Salvador Terol* and Roland Ward

Properties of lanthanum aluminum oxide as a phosphor base material have been studied. The purest available lanthanum oxide samples gave products which were weakly cathodoluminescent due to the pressure of praseodymium or samarium as impurities. The rare earth ions Pr^{+3}, Sm^{+3}, and Eu^{+3} were the only activators which were found to be effective. Emission spectra of these phosphors are given.

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* Present address: Optical Institute and Naval Research Laboratory, Madrid, Spain.

Other usual activators were found to be ineffective. Presence of rare earth impurities causes a pronounced body color to develop in the lanthanum aluminum oxide when samples are ignited in air. This proves to be a more sensitive means of detecting impurities than spectrographic analyses.

Abstract No. 50

TWO ARSENATE PHOSPHORS AND THE SIGNIFICANCE OF THEIR EMISSION

G. R. Fonda

Phosphors of moderate luminescence have been prepared from zinc arsenate activated with lead or manganese, and from calcium fluoarsenate activated with antimony and manganese. Their manganese emission bands are shifted to longer wave lengths than is characteristic of their phosphate homologues, from 6380 A to 6550 A for the zinc compounds, and from 5680 A to 6200 A for the fluoapatites. The effect is ascribed to a depression of the activator excitation levels under the increased field exerted by oxygen ions at closer packing.

Abstract No. 51

THE SYSTEM CADMIUM OXIDE-BORIC OXIDE

E. C. Subbarao and F. A. Hummel

Phase relationships in the system CdO-B_2O_3 were investigated by the quench method and by differential thermal analyses. A large region of liquid immiscibility extends from practically 100% B_2O_3 to about 46% B_2O_3. The compounds $2CdO \cdot 3B_2O_3$ (44.86% B_2O_3), $3CdO \cdot 2B_2O_3$ (26.55% B_2O_3), $2CdO \cdot B_2O_3$ (21.33% B_2O_3), and $3CdO \cdot B_2O_3$ (15.31% B_2O_3) were characterized by x-ray diffraction, optical, and thermal data. The 2:3 and 3:2 compounds melt congruently around 1000°C and form a

simple eutectic system. A large volume change attends a polymorphic inversion in the 3:1 compound. No inversions were detected in the remaining compounds. The solid solubility of MnO in the 2:3, 3:2, and 2:1 compounds was determined.

Abstract No. 52

LUMINESCENT SCREENS MADE BY VAPOR REACTION

D. A. Cusano and F. J. Studer

The vapor reaction method of making transparent phosphor screens will be described and the properties of these screens discussed. Coatings of zinc sulfide, either self-activated or with arsenic, copper, manganese, or phosphorus as activators, have been made which respond well to cathode rays. Screens made with arsenic and phosphorus as combined activators give a white emission. Vapor reaction coatings of ZnS may be made in such a way that they exhibit electroluminescence. In addition, appropriately deposited layers have the property that luminescent response to u.v. is enhanced by a d-c field.

Abstract No. 53

CATHODOLUMINESCENT LAMPS

L. R. Koller

Measurements have been made of the voltage drop when an electron beam passes through a fluorescent screen. This varies from a few volts to several hundred volts depending on the nature of the phosphor. By choosing phosphors with high conductivity, the major part of the voltage drop across an electron tube is made available for excitation of the phosphor. This principle is applied to the construction of 120 v cathodoluminescent lamps.

Abstract No. 54

COLOR SHIFTS IN Zn-Cd-S (Ag) PHOSPHORS

Vanja Srepel

The emission of a zinc-cadmium-sulfide phosphor, activated with silver, shifts to shorter wave lengths as the density of the exciting electron beam increases. An explanation of this phenomenon is based on Schoen-Klasens' theory of double band emission in Zn-Cd-S (Ag) phosphors. The effect of increasing cadmium and silver content is discussed, with energy levels calculated for those systems. Several examples are cited to illustrate the practical application of the described effect.

ELECTRONICS—OXIDE CATHODES

Abstract No. 55

FUNDAMENTAL PHENOMENA OF THERMIONIC EMISSION

W. B. Nottingham

(No abstract available)

Abstract No. 56

A NEW SINTERED TUNGSTEN MATRIX CATHODE

E. A. Thurber

The history of magnetron cathodes will be reviewed briefly, providing some background information essential to a fuller appreciation of recent design problems and their solution. In particular, the development of a new oxide-coated coexpansive system comprising a sintered tungsten matrix on a

molybdenum base will be described. The new cathode will be compared with older types from the standpoints of electrical performance, mechanical strength, refractory properties, thermal and thermionic stability, and general reliability.

Abstract No. 57

SOME STUDIES ON PROBLEMS ASSOCIATED WITH THE MOLDED NICKEL CATHODE

I. J. Bell and G. R. Brewer

Some problems encountered in the fabrication and processing of the molded nickel cathode will be discussed, together with methods which have been successful in their solution. Particular emphasis will be placed on the effect of composition and sintering schedule on the emission and life obtainable for cathodes containing carbon as a reducing agent. Data on pulsed and d-c emission and life tests will be presented.

Abstract No. 58

SOME APPLICATIONS OF L CATHODES

J. Babakian,* A. Matthewson, and J. Bloom

A few years ago a general evaluation was made of the L cathode. Its pulse emission characteristics in high vacuum diodes were covered quite thoroughly. Since then the L cathode and its impregnated version have been applied in specific tube development projects. Some interesting facts have emerged on high voltage operation, cathode activation, and resistance to ion bombardment. In a helium thyratron this ion re-

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sistance has proved of particular interest and will be covered in detail.

Abstract No. 59

MANUFACTURING ADVANTAGES OF THE PHILIPS IMPREGNATED CATHODE USED IN MAGNETRON APPLICATIONS

Markus Nowogrodzki

The historical development of the Philips impregnated cathode is traced briefly, its salient design features are reviewed, and the advantages of its employment in magnetron applications are cited. Some of the characteristics of the impregnated cathode are discussed in greater detail (e.g., operating temperature), and experiences arising from the use of this type of emitter in a 4J52 magnetron are related. Electrical advantages of the impregnated cathode are still being studied. It already appears certain, however, that employment of this type of emitter in magnetrons leads to improved stability, excellent life characteristics, and the use of the tubes with much longer pulses than had hitherto been possible.

Abstract No. 60

EMISSION FROM MOLYBDENUM ACTIVATED WITH BARIUM*

R. H. Ahlert and E. S. Rittner

This talk will describe experiments designed to provide information on (a) emission capabilities of molybdenum surfaces activated by barium supplied either by evaporation or by surface migration from the active tungsten member of Philips dispenser

* Work supported by the Bureau of Ships under Contract No. NObsr-64043.

cathodes, and (b) the migration length of barium over molybdenum. These experiments have revealed that molybdenum emits about as well as tungsten, provided that the activating stream contains, in addition to barium, some barium oxide to replace losses of adsorbed oxygen, and that the migration length is a small fraction of a millimeter and decreases with increasing temperature.

Abstract No. 61

AN INVESTIGATION OF THE IMPREGNATED CATHODE*

W. C. Rutledge, E. S. Rittner,
and R. H. Ahlert

Comparison is made between the impregnated cathode** (type BP1A) and the L-cathode with respect to electron emission and product evaporation. Evaporation studies include: (a) qualitative identification of the metallic constituents; (b) measurement of the instantaneous evaporation rates of total Ba and BaO as a function of temperature and life; and (c) interpretation of these rates in terms of the barium transport mechanism. Finally, possible reasons for differences in performance between the two cathodes are discussed.

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* Work supported by the Bureau of Ships under Contract No. NObsr-64043.

** R. Levi, J. Appl. Phys., 24, 233 (1953).

Abstract No. 62

IMPROVED PHILIPS "IMPREGNATED CATHODE"

Roberto Levi

A greatly improved version of the "impregnated cathode" has been developed. The new emitter has the following advantages over its predecessor: substantially higher

emission current density; shorter aging time required after removal from the pumping system; and lower rate of barium evaporation at equal operating temperature. Since a given emission current density is now obtained at a lower temperature, the rate of barium evaporation is still further reduced relative to the old version.

Abstract No. 63

CHEMICAL PROCESSES IN THIN-FILM DISPENSER CATHODES

R. C. Hughes and P. P. Coppola

Thin-film dispenser cathodes composed of barium compounds and a refractory metal are discussed from the viewpoint of the chemical processes responsible for forming and maintaining the activating adsorbed monolayer. Among the processes considered are: (a) reactions for generating free barium; (b) other chemical processes involving barium and the refractory metal matrix; (c) behavior of BaO within the refractory metal matrix; and (d) desirable types of barium sources.

Abstract No. 64

A NEW PRESSED DISPENSER CATHODE

P. P. Coppola and R. C. Hughes

The preparation of a dispenser cathode wherein an alkaline earth material is dispersed in the pores of a refractory metal through the use of standard powder metallurgy technique is discussed. Two conditions are necessary for making a satisfactory cathode: (a) absence of oxidizing gases; and (b) a chemical system designed to dispense barium to the free surface of the cathode at a controlled slow rate. These conditions are met by the use of a reaction product of barium oxide and aluminum oxide

combined with a molybdenum-tungsten alloy. Emission, life, evaporation, work function, and other pertinent characteristics are presented.

Abstract No. 65

THERMIONIC EMISSION EVALUATION OF SINGLE CONSTITUENT ADDITIVES IN PURE NICKEL CATHODES*

F. T. Hill

Cathode alloys were prepared with silicon, tungsten, magnesium, titanium, aluminum, and molybdenum as single additives in intrinsically pure vacuum melted nickel. Cathode sleeves, fabricated from these alloys, were tested in an A.S.T.M. standard diode constructed with pure nickel metallic parts. All tubes were cathode temperature controlled during exhaust, activation, and life burning. During intervals of life burning, the tubes were tested for different emission parameters. Detailed results for cathode work factor, pulse emission, interface resistance, cathode sublimation, and heater-cathode leakage will be discussed.

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* Sponsored by Bureau of Ships.

Abstract No. 66

APPLICATION OF AUTOMATIC RECORDING INSTRUMENTS TO THE MEASUREMENT OF EMISSION

A. N. Yeaton and C. D. Richard, Jr.

Automatic recording instruments applied to the measurement of cathode emission have provided new and improved data for interpreting performance characteristics of vacuum tube cathodes. The use of these instruments has permitted relatively unskilled

personnel to obtain accurate test results. Emission data, plotted continuously by a recording potentiometer during early life hours, depicts the rate of activation. Conventional reading of tubes at stated life hours fails to show the changes in emission with sufficient accuracy. Various grades of cathode alloys are now differentiated clearly. An X-Y plotter provides improved static emission measurements showing the state of activation and stability of the electron tubes at specific hours during the life test.

Abstract No. 67

A SIMPLIFIED GAS ADSORPTION METHOD FOR THE DETERMINATION OF SURFACE AREA OF FINE POWDERS

D. T. Palumbo, F. M. Starkweather, and D. J. Bracco

The standard Brunauer-Emmett-Teller (BET) gas adsorption method has been simplified to permit a more rapid determination of the surface area of fine powders. A comparison of both methods with triple carbonates, zinc sulfide, zinc silicate, and cadmium sulfide powders shows that the rapid method is usually within 10% of the standard method. The observed deviation is always in the same direction, giving lower surface area values than the standard procedure. The utility of the method for investigations in emission carbonate preparations is illustrated.

Abstract No. 68

ELECTRICAL PROPERTIES OF THE OXIDE CATHODE COATING

Ralph Forman

Electrical conductivity, Hall effect, and magnetoresistive measurements have been made

on the oxide cathode coating in the temperature range 500°-1000°K. Results indicate that the electrical properties of the oxide coating are dependent on the degree of porosity of the cathode deposit. The data are in agreement with a porous semiconductor model. The experiments will be described, and some applications resulting from this work will be illustrated.

Abstract No. 69

ACTIVATION OF AN OXIDE CATHODE BY Ba, Sr, Ca, AND Mg DEPOSITED VIA A MASS SPECTROMETER

R. M. Matheson and R. H. Plumlee

Ionic beams of Ba, Sr, Ca, and Mg separated by means of a mass spectrometer were deposited on the surface of an oxide cathode. The variation of cathode activity during and subsequent to the period of deposition was observed. Total deposits were varied from 0.01 to 1.5 monolayers. The increase in cathode activity was the same, within the limits of experimental accuracy, when equal numbers of Ba, Sr, Ca, or Mg ions were deposited.

Abstract No. 70

MASS SPECTROMETRIC STUDY OF THE FIELD DEPENDENT EVOLUTION OF CONSTITUENTS OF A BaO CATHODE

R. H. Plumlee

The purpose of this experiment was that of measuring the dependence of the evolution of oxygen and/or Ba, from a BaO cathode, on temperature, time, state of activation, duty cycle, and on electric field produced across the BaO coating during the drawing of electron emission. The following volatile constituents were found to be loosed from the

BaO cathode by application of positive anode voltages to the electron collector: H_2, H_2O, O_2, CO, and CO_2.

Abstract No. 71

FACTORS INFLUENCING THE PARTICLE SIZE IN THE PREPARATION OF ALKALINE EARTH CARBONATES

D. T. Palumbo, D. J. Bracco, and A. K. Levine

The effect of pH, temperature, and concentration on the particle size of precipitated alkaline earth carbonates is shown. Particle size is measured by gas adsorption and checked by optical and electron microscopy. Preparation conditions studied are such as to give a range of mean particle diameters extending over three orders of magnitude.

ELECTRONICS--PHOSPHOR APPLICATION

Abstract No. 72

PARTICLE SIZE METHODS FOR TV PHOSPHORS

J. Rabatin, E. Palik, and R. Gale

Methods of determining particle size distribution in TV phosphors will be discussed and advantages and disadvantages of the more feasible methods will be considered. Consideration will be given to relationships existing between the dry powders and the corresponding phosphors in the conventional settling media. Possible advantages in restricting the range of particle distributions and the effects of wide and narrow distributions on the uniformity of phosphor screens will be considered.

Abstract No. 73

THE USE OF POLYVINYL ALCOHOL IN THE PREPARATION OF COLOR PHOSPHOR SCREENS

The Staff
Parlin Laboratories
E. I. du Pont de Nemours and Co.

Methods of using sensitized polyvinyl alcohol in laying down precise phosphor patterns for use in color tubes will be described. Physical and chemical characteristics of the sensitized material will be discussed with particular emphasis on those characteristics important to its use in laying down screens. Topics such as solution concentrations, sensitization, development, fixing, and bake out will be discussed.

Abstract No. 74

KELVIN METHOD OF SCREEN POTENTIAL MEASUREMENT AND SCREEN CHANGING

J. T. Young

A simple, reliable method of high accuracy is described for the measurement of screen potential on production cathode ray tubes. Experimental results using the apparatus described will be given. Variables such as surface effects, phosphor-coating thickness, coverage, particle size, and their effect on screen changing will be described.

Abstract No. 75

ION FOCUSING FIELDS AND ION DETERIORATION EFFECTS ON CATHODE RAY TUBE SCREENS

W. A. Thornton

The role of focusing fields in the formation of ion-burn patterns is discussed. Results that have been obtained as regards

focused ion patterns and their dependence on anode geometries and screen potential configurations will be given. Positive ion production and the effects on phosphor deterioration will be considered.

Abstract No. 76

SECONDARY ELECTRON YIELDS OF SCREEN MATERIALS

A. B. Laponsky

A procedure for the measurement of secondary yields is described. The effects of the collection field and electron bombardment on yield are discussed. Results of measurements of the secondary yield of a number of commercial phosphors as a function of bombarding energy and time are given. Conclusion of secondary yield to ion burn of the phosphor is established.

ELECTRONICS--SEMICONDUCTORS

Abstract No. 77

PROPERTIES OF GERMANIUM AND SILICON

E. M. Conwell

The knowledge of the band structure of germanium and silicon, obtained from cyclotron resonance, has made it possible to account for many hitherto unexplainable experimental results. Some of this work, such as that on infrared absorption of holes and magnetoresistance of electrons and holes, will be reviewed. Some of the latest information on properties and concentrations of impurities and other imperfections, particularly in silicon, will also be covered.

Abstract No. 78

INJECTION AND EXTRACTION*

Ralph Bray

Reproducible highly injecting and extracting** low resistance base contacts on p- and n-type Ge have been made with pure In and Sn as solder. Such contacts are useful to control the resistance of both bulk and junctions. For example, considerable bulk rectification is achievable, especially when operating at large minority carrier concentration due to heat or light. Also, interesting modifications of collector contact properties, especially peak back voltage, are obtainable in light and dark.

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* Work assisted by Signal Corps Contract.

** R. Bray, Bull. Am. Phys. Soc., Abstract: G6, Chicago, November 1954.

Abstract No. 79

THE GERMANIUM-OXYGEN SYSTEM*

Donald Tuomi** and E. S. Candidus

The reaction of hexagonal and tetragonal GeO_2 with Ge has been investigated between 800° and 960°C. A eutectic was observed at 870°C at a composition corresponding to 60 atomic per cent oxygen. Above 940°C liquid Ge is in equilibrium with a liquid oxide containing approximately 60 atomic per cent oxygen. The solid solubility of oxygen in Ge is small. The literature pertaining to the

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* The research in this document was supported jointly by the Army, Navy, and Air Force under contract with the Massachusetts Institute of Technology.

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phase diagram will be reviewed and the relationship of the phase diagram to germanium technology will be discussed.

Abstract No. 80

DONOR-ACCEPTOR BALANCE IN SELENIUM RECTIFIERS

H. W. Henkels

A description of the bulk properties of selenium is given in which the effects of metals and nonmetals on the electrical properties are attributed to the presence of donors and acceptors, respectively. The practical selenium rectifier is studied in terms of an equilibrium p-n junction theory, i.e., one in which lifetimes of injected carriers are zero. The effect of variations of donor and acceptor densities on the processing and product of practical selenium rectifiers is discussed.

Abstract No. 81

CORRELATION OF ELECTRICAL PROPERTIES OF SELENIUM RECTIFIERS WITH FUNDAMENTAL BULK PROPERTIES

H. W. Henkels

Properties of rectifiers, forward drop, reverse leakage, and the temperature dependence of these quantities are studied in relation to the microstructure of the selenium. Past published work has correlated the microstructure of selenium with the electrical properties of the bulk. Consequently, the electrical properties of the rectifier can be described in terms of the bulk properties of selenium, these including--besides the usual acceptor densities, mobilities, and contact differences in potentials--terms describing the microcrystalline state.

Abstract No. 82

REVIEW OF THE STATE OF SEMICONDUCTOR SURFACES*

R. H. Kingston

A semiconductor surface may be characterized by the energy and density of available electron states present in addition to the bulk states. These "surface states" are shown to be critically dependent on the mechanical and chemical treatment, the amount of oxidation, and the amount and species of adsorbed material. Such quantities as surface conductance, recombination velocity, contact potential, and excess noise may be correlated with surface history, leading to a possible understanding of the over-all state distribution.

* The research in this document was supported jointly by the Army, Navy, and Air Force under contract with the Massachusetts Institute of Technology.

Abstract No. 83

ULTRAHIGH VACUUM STUDIES ON GERMANIUM SURFACES

F. G. Allen

Measurements were made of the contact potentials of a pair each of (100), (110), and (111) faces of the same single germanium crystal using the Kelvin method of vacua of 10^{-8} to 10^{-10} mm Hg. Cleanliness of the surface is indicated by matching of values for like faces. Differences in work function between different faces on the order of 0.05 v are indicated. Values on all faces are light-sensitive even after cleaning treatments. This effect and its frequency dependence are strongly affected by temperature.

Abstract No. 84

THEORY OF SURFACE-BARRIER ELECTRODES

W. E. Bradley

The electrical properties of conducting contacts chemically bonded to the surface of a semiconducting crystal depend upon the chemical potential of the complex structure confronting the semiconductor. The effective chemical potential of the electrode is shown to be strongly affected by the structure of the first few layers of the electrode confronting the semiconductor and to a lesser extent by the bulk of the conducting contact. It is shown that very slight chemical modification of a thin oxide layer between a metal electrode and a semiconductor can cause it to function either as a rectifier or as an ohmic contact.

Abstract No. 85

HOLES AND ELECTRONS IN GERMANIUM ELECTRODES

C. G. B. Garrett and W. H. Brattain

At a germanium electrode there exist two boundary layers, one in the electrolyte and the other in the semiconductor. Using techniques developed for the study of holes and electrons in germanium, it has been possible to distinguish the potential drops occurring across the two layers, and to draw conclusions as to the separate roles of electrons and holes in the electrode reactions. Deductions may be made as to the mechanism for the observed effects of humidity on germanium rectifiers and transistors.

Abstract No. 86

EFFECT OF SURFACE TREATMENTS IN LOW PRESSURE GAS ATMOSPHERES ON CHARACTERISTICS OF EVAPORATED SURFACE-BARRIER RECTIFIERS

P. A. Hartig

A low energy gas discharge on the surface of clean 5 ohm-cm germanium prior to evaporating a platinum diode produced results dependent on the gas used. Oxygen and nitrogen each destroyed rectification completely on n-type material, while hydrogen not only maintained it, but tended to counteract the effect of the other gases. These results indicate that the oxygen and nitrogen lower the barrier, making the surface more n-type, while the hydrogen makes it more p-type.

Abstract No. 87

EFFECT OF WATER VAPOR ON GERMANIUM AND SILICON JUNCTIONS

J. T. Law and P. S. Meigs

Two mechanisms have been proposed for the increase in reverse current found when junction units are exposed to water vapor. These are: (a) channel conductance; and (b) ionic leakage. The present work has shown that both are present but that (a) predominates for silicon and (b) for germanium. The two effects can be separated by changing the temperature of the sample and the amount of steady light illumination. The difference between silicon and germanium is explained in terms of an insoluble oxide film on the silicon surface.

Abstract No. 88

OBSERVATIONS OF CHANNEL FORMATION ON N- AND P-TYPE SEMICONDUCTORS

R. N. Noyce

A visual display of channel formation has been obtained by focusing the raster of a flying spot scanner on a grown junction

diode and presenting the photovoltage produced on a television display. This allows the observation of transient phenomena. If the light is chopped at a high frequency, the resolution of the channel observation is improved from the usual diffusion length to the high frequency diffusion length, $\sqrt{D/\omega}$. In conjunction with measurements of the changes in surface conductance, this allows the determination of the surface Fermi energy for various ambient conditions.

Abstract No. 89

OXIDATION OF CLEAN SURFACES OF GERMANIUM BELOW 25°C*

Mino Green and J. A. Kafalas

The oxidation of clean surfaces of germanium in wet and dry oxygen has been studied in the temperature range -68°C to +25°C and the oxygen pressure range 1 to 200 microns. Fresh surfaces were obtained by crushing the germanium in an all-glass system in the presence of the gas to be adsorbed. The uptake of oxygen was not affected by the presence of water vapor. The oxygen uptake was approximately 3 oxygen atoms per surface germanium atom at 25°C, and was 10% less at -68°C. There was no appreciable difference in the extent of oxidation between n- and p-type germanium. Complete oxygen uptake occurred in < 5 sec over the pressure range investigated.

* The research in this document was supported jointly by the Army, Navy, and Air Force under contract with the Massachusetts Institute of Technology.

Abstract No. 90

ETCHES FOR IMPERFECTIONS IN SILICON AND GERMANIUM

J. W. Faust, Jr.

A knowledge of the degree of perfection of a crystal is vital not only for the production of semiconducting devices but also for many fundamental investigations. Etching is a convenient method for exposing imperfections and is especially useful where x-ray equipment is not available. Furthermore a great deal of useful information about a crystal can be obtained by studying the effects of different etches on a given surface. Various etches for both silicon and germanium will be discussed briefly, followed by an account of their role in imperfection studies.

Abstract No. 91

THEORY OF JET ETCHING ELECTROLYTIC ETCHING OF SEMICONDUCTORS

W. E. Bradley

The possible existence of potential differences within a semiconducting body and the fact that its conductivity may depend upon the degree of illumination strongly affect the process of electrolytic etching as used in the construction of semiconductor devices. Localization of etching action by the use of jets of electrolyte is also a convenient means for control of the process. A variety of structural results which can be achieved by combinations of these factors are shown.

Abstract No. 92

THE PURIFICATION OF GERMANIUM The Germanium Tetrachloride-Arsenic Trichloride System*

* The research in this document was supported jointly by the Army, Navy, and Air Force under contract with the Massachusetts Institute of Technology.

Mino Green and J. A. Kafalas

The vapor-liquid equilibrium has been determined over a wide concentration range in the anhydrous system germanium tetrachloride-arsenic trichloride. A relative volatility of 2.52 ± 0.035 was found for mixtures containing < 0.05 mole fraction $AsCl_3$ in the liquid. Distillation in a Pyrex glass assembly or a quartz assembly gave theoretically predicted values of fractionation if the arsenic concentration was followed using radioactive As^{74}. However, if the arsenic fractionation was determined by absolute arsenic analysis the Pyrex assembly gave very low fractionation whereas the quartz assembly gave near ideal values. This discrepancy for a Pyrex distillation unit is attributed to the leaching of arsenic from the glassware.

Abstract No. 93

NEW METHOD FOR PRODUCING HIGH PURITY SILICON

Gustav Szekely

Some of the conditions necessary for chemically preparing high purity silicon will be discussed. A reaction system fulfilling these conditions and involving the reduction of silicon tetraiodide by hydrogen will be presented. Some of the characteristics of the reaction will be described, and a representation of the apparatus in which the reaction is carried out will be shown. Information on the basic process parameters, such as [illegible] and yield, will be given. The ability of the process to produce highly pure silicon will be demonstrated.

Abstract No. 94

DEPTH OF SURFACE DAMAGE DUE TO ABRASION ON GERMANIUM

T. M. Buck and F. S. McKim

The approximate depth of surface damage on germanium, as evidenced by surface recombination velocity, has been measured for various abrasive treatments by etching, weighing, and measuring the photoelectromagnetic voltage of thin specimens. The values range from 1 micron for fine polishes to 32-34 microns for heavy sandblasting. Close correlation is found with the changes in reverse characteristics of grown junction p-n diodes treated in the same way.

Abstract No. 95

ELECTROCHEMICAL PREPARATION OF GERMANE*

Mino Green and P. H. Robinson

Electrochemical systems of the kind, Metal/GeO_2, water, NaOH or H_2SO_4/Pt anode, have been investigated with a view to finding the system which gave the highest GeH_4 yield. The system Hg(Na)/GeO_2, $NaOH_{(aq.\ solu.)}$/Pt gave the highest yields. Data are presented for the effects of different GeO_2 concentrations, NaOH concentrations, current densities, and cathode stirring rates on the current efficiency for GeH_4 production and the relative amounts of GeH_4, Ge, and H_2 produced. The effect of added NaCl and added As_2O_3 was determined. The influence of concentration changes at the cathode surface is discussed.

* The research in this document was supported jointly by the Army, Navy, and Air Force under contract with the Massachusetts Institute of Technology.

Abstract No. 96

THE PRESENT STATUS OF INTERMETALLIC SEMICONDUCTORS

R. G. Breckenridge

Since the recent discovery of the semiconducting nature of a number of intermetallic compounds, very rapid progress has been made in the study of their properties. The most important features of the $A^{III}B^{V}$ and $A^{II}B^{IV}_{2}$ type compounds have now been revealed and some work has been done on several other miscellaneous compounds. The current trend of research is toward the production of ultrahigh purity single crystal samples of many of these compounds. As such samples become available, finer details of their electronic structure are coming under study and a number of interesting new properties have been discovered.

Abstract No. 97

EFFECT OF ZONE-REFINING VARIABLES ON THE SEGREGATION OF IMPURITIES IN InSb*

T. C. Harman, R. K. Willardson,
H. L. Goering, and A. C. Beer

Electrical, spectrographic, and activation analyses were carried out on extensively zone-refined InSb. The most slowly segregating impurity was found to be n-type; it lowered the melting point. The second most slowly segregating impurity was shown to be p-type; it raised the melting point. The identity and source of the two impurities, their concentration and distribution in zone-refined ingots, and their effects on the electrical properties of the InSb will be discussed. Results on effective removal of these impurities will be given.

* Supported in part by Wright Air Development Center.

Abstract No. 98

PHOTOEFFECTS IN InSb*

S. W. Kurnick, A. E. Goldberg,
G. M. Mitchell, and R. N. Zitter

Phototransistor, photoelectromagnetic (PEM), and photoconductive effects occur in InSb. P-n junctions have been pulled from the melt; at liquid nitrogen temperatures these junctions show photovoltaic and phototransistor responses. Surface recombination rates and bulk lifetimes have been evaluated from the PEM and photoconductive response at liquid N_2 temperatures using a constant-relaxation-time model for carrier transport. Response is strongly dependent on surface preparation (electropolished or mechanically polished). The temperature-dependence of the PEM effect is discussed.

* This work is being supported in whole by the U. S. Air Force under contract number AF 33(038)-25913.

Abstract No. 99

EFFECT OF IMPURITIES ON PHOTOCONDUCTIVE CdS, CdSe, AND PbS

W. B. Hugle

The effects of added impurities on photoconduction in PbS, CdS, and CdSe films and single crystals are shown to be divided into two distinct categories: (a) the CdS, CdSe group, and (b) PbS. In the first case a large group of activators are shown to improve the photoconductivity markedly while in the second case the effects (with one or two exceptions) are primarily negative: either the photoconductivity is "poisoned" or the growth of the films inhibited.

Abstract No. 100

EXPERIMENTS ON THE FORMATION OF ANODE FILMS ON InSb

J. F. Dewald

Anode films have been formed on indium antimonide. Kinetics of formation have been studied on three crystallographic faces, 110, 332, and $\bar{3}32$. Significant differences between the faces have been observed and these are interpreted in terms of theories previously developed by Cabrera and Mott and extended by Dewald. Films formed in KOH solution (which should dissolve any antimony oxide) are, rather surprisingly, found to contain large amounts of antimony. A study of the antimony distribution through the film under a variety of conditions of formation has been made. The results give new insight into the detailed mechanism of film formation.

ELECTROTHERMICS AND METALLURGY

Abstract No. 101

ELECTRIC SMELTING FURNACES

M. J. Udy

Design and operation of electric smelting furnaces go hand in hand. Stansfield says the kilowatt hour per cubic foot of molten material is the one big factor. Andreae has shown that the peripheral ohms factor is a constant for slag forming or smelting operations. Both factors are basically true, but they must be properly coordinated with operation to get the best results. In some recent work the peripheral ohms factor does seem to be enough where slags of very high resistance are encountered. A factor that seems to be

more useful is the kilowatt per square inch of electrode in contact with the slag or the kilowatt per square inch of periphery in contact with the slag.

Abstract No. 102

THE USE OF ELECTRIC FURNACES BY THE BUREAU OF MINES IN FERROALLOY RESEARCH

N. B. Melcher

The Bureau of Mines has utilized electric furnaces for research and process development extensively. Facilities are often used for cooperative projects with industry and Government agencies. Some projects involve many months of work, whereas the solution to others has been obtained rapidly. Many processes used commercially resulted from such work. The furnaces range from large arc melting furnaces of 1-ton capacity powered with 500 kw and smelting furnaces of 1000 kw through small arc furnaces, induction furnaces, and resistance furnaces.

Abstract No. 103

HIGH SPEED ELECTROHYDRAULIC ARC FURNACE CONTROL

W. Nordin

Needs and purposes of arc furnace control, causes of power fluctuations and ways for regulating the power, electric and hydraulic electrode regulators, stability and speed of response, a Swedish high speed electrohydraulic electrode regulator, achieved results, and economic and electric advantages are discussed.

Abstract No. 104

THE TREND IN ELECTRIC FURNACE DESIGN PARTICULARLY AS IT APPLIES TO THE PRODUCTION OF CALCIUM CARBIDE

J. C. Bode

This paper gives a brief review of the developments in furnace design. Size and shape will be considered, together with electrode spacing and power densities. Some of the newer features, such as enclosures, roofs, and furnace rotation will be dealt with, principally from the standpoint of why the developments came about, together with the economic factors which justified them. An attempt will be made to speculate briefly on what future developments might be, together with some of the limitations which are believed to exist today.

Abstract No. 105

THE FERROALLOY INDUSTRY IN AUSTRALIA

R. H. Hooper

Prior to the last war the Australian steel industry depended on overseas supplies of ferroalloys. In 1940 a modern ferroalloy plant, using Lectromelt ferroalloy furnaces, was erected within the steel works of the Broken Hill Proprietary Company Limited at Newcastle, N.S.W., and in this plant practically all ferroalloys have been produced for Australia since that time. This paper covers the development of this industry from its infancy to its present-day large proportions.

Abstract No. 106

MATERIALS PREPARATION FOR A FERROALLOY OPERATION

D. E. Stingel

This is a discussion covering the sources and geological background of necessary large quantity supplies of quartzite and gravel of high purity and consistent analyses for use in ferrosilicon operations; including a description of quarrying methods, crushing, sizing, washing, sampling, shipping to and storage at customers' plants; further preparation for furnace use in mixture with reducing agents, such as low ash coal, petroleum coke and wood chips, and steel; and procedure followed to combat segregation.

Abstract No. 107

MATERIALS HANDLING AND PREPARATION OF RAW MATERIALS FOR FERROALLOY FURNACES

R. A. Davidson

This paper summarizes various conventional methods of handling the most common raw materials used in the ferroalloy industry from railroad cars through the storage and batching system to the electric furnaces. The new integrated silo-type materials handling storage and batching system recently installed at the Cambridge, Ohio, plant of the Vanadium Corp. of America is described in considerable detail.

Abstract No. 108

THERMODYNAMICS OF THE OXIDATION OF CHROMIUM

J. N. Ramsey, D. Caplan, and A. A. Burr

By a microbalance technique in which oxidized chromium sheet is heated in prepared H_2/H_2O atmospheres the dissociation pressure of Cr_2O_3 is determined over the temperature range 1100°-2200°F (593°-1204°C). From these data are calculated the enthalpy, entropy, and free energy change for the oxidation of chromium.

Abstract No. 109

HIGH TEMPERATURE OXIDATION OF TWO ZIRCONIUM-TIN ALLOYS

M. W. Mallett and W. M. Albrecht

Reaction of dry oxygen with a zirconium-1.5 wt % tin alloy and a zirconium-2.5 wt % tin alloy followed the cubic rate law and the parabolic rate law, respectively, in the range 550°-900°C at 1 atm pressure. Oxidation films were found to be N-type semiconductors from which the mechanism for the oxidation of zirconium is proposed. The tin content of the alloys increased the porosity of the films, and decreased the time before breakdown of the protective properties of the film.

Abstract No. 110

REACTION OF NITROGEN WITH URANIUM

M. W. Mallett and A. F. Gerds

Rates of reaction of nitrogen with uranium were determined in the temperature range 550°-900°C at atmospheric pressure. The reactions were found to follow a parabolic rate law with some deviations initially and also after the period of parabolic reaction. Surface reaction products found in the temperature range of 350°-750°C were identified by x-ray diffraction studies and shown to consist principally of UN_2 with slight indication of U_2N_3. Between 775° and 900°C the nitrides UN, U_2N_3, and UN_2 were found in the surface reaction products.

Abstract No. 111

OXIDE NUCLEATION AND THE SUBSTRUCTURE OF METALS

E. A. Gulbransen, W. R. McMillan,
and K. F. Andrew

Experiments show that oxidation of iron occurs in a discontinuous manner under conditions of low oxygen pressure and at temperatures of 650° to 850°C. This discontinuous oxide pattern results from the formation of individual nuclei at defects in the metal structure and at grain boundaries. Experiments are made for a number of pretreatment procedures including high vacuum annealing and hydrogen annealing. The oxide pattern varies with pretreatment and with impurities in the metal or gas atmosphere. It is suggested that the method can be used for the study of the substructure of metals.

Abstract No. 112

EROSION OF STEEL BY GASES

M. J. Fraser and A. A. Burr

A venting device has been developed for producing eroded surfaces on steel and other metals. This apparatus consists essentially of an explosion chamber where gases at high temperature and pressure are produced and a rupture disk assembly which allows the gases to pass at high velocity over the metal surface to be studied. Interaction between the gas and metal takes place without surface fusion. Surfaces so treated have been shown by metallographic and x-ray analysis to duplicate structures encountered in many service applications. During the process of erosion at least 4 distinct surface layers develop. A number of steels have been studied in an attempt to correlate erosion behavior with composition.

Abstract No. 113

STRESS CORROSION CRACKING IN MAGNESIUM

D. K. Priest and M. G. Fontana

A dynamic record on moving picture film is presented of the progress of stress corrosion in the A Z 61 alloy. Pictures are made at magnifications of 40 and 80 diameters. The effects of heat treatment and cathodic protection are demonstrated. Examples of both transgranular and intergranular corrosion are evident. Mechanisms are briefly discussed.

Abstract No. 114

ELECTROCHEMICAL TECHNIQUES IN THERMODYNAMICS

R. A. Oriani

The use of galvanic cells employing nonaqueous electrolytes and operating at elevated temperatures is a relatively little known technique. Some of the details for the successful operation of such cells are described both for liquid and for solid alloys. The kind and the accuracy of the information obtained are discussed. Applications to the determination of phase diagrams are outlined, and the possibilities of obtaining surface free energies are discussed.

Abstract No. 115

RELATIONS BETWEEN MECHANICAL DEFORMATION AND THERMOELECTRIC FORCE

J. M. Berry

A technique was used by which it was possible to measure the thermoelectric emf between undeformed metal and metal either elastically or plastically deformed. The results of reversible heat experiments were consistent with the idea that the junctions of undeformed with deformed metal are sources of thermoelectric emf. The thermoelectric properties of the copper and copper-base

solid-solution alloys, used in this work, were found to be affected by changes in either elastic or plastic deformation. The implications of these experiments may also be of importance for thermoelectric pyrometry.

Abstract No. 116

HIGH PURITY MANGANESE FROM LOW-GRADE INDIAN ORES

A. Jogarao, Y. D. Prasada Rao, and S. Gopal

Using a method similar to the one adopted by the U. S. Bureau of Mines, it has been found possible to produce successfully manganese metal of 99.96% Mn-purity from typical low-grade ores of India, for which, at present, there is no export-market. The significant deviations in this process, as the authors have been working in their 10 lb/day laboratory unit-plant are: (a) elimination of sulfides-precipitation; and (b) elimination of atmospheric or oxygen-bubbling for removal of iron.

Abstract No. 117

MELTING AND DEOXIDIZING WITH ATOMIC HYDROGEN

P. C. Rossin

Dissociated hydrogen as supplied by an atomic hydrogen welding torch represents an ideal melting and deoxidation mechanism. Preliminary operation of a furnace designed to maximize the formation and control of dissociated hydrogen has produced small ingots (5 g "buttons") of Fe, Mo, Cr, W, Co, Cu, Ni with oxygen levels as low as 5 parts/million (wt %). Photomicrographs of the elements listed above, when atomic hydrogen melted, are completely single phase at 2000 X.

Abstract No. 118

PRELIMINARY INVESTIGATION OF HAFNIUM METAL BY THE KROLL PROCESS

H. L. Gilbert* and M. M. Barr

Several hundred pounds of hafnium metal of better than 98% purity have been produced by the Kroll process of magnesium reduction of the tetrachloride. A discussion of the process from oxide to metal stages is given, with thermodynamic values for chlorination and reduction. Metal produced to date is hot malleable but not cold ductile.

* Present address: Harvey Aluminum, 19200 South Western Ave., Torrance, Calif.

Abstract No. 119

BOMB REDUCTION OF MOLYBDENUM TRIOXIDE BY CALCIUM METAL

H. L. Gilbert* and F. E. Block

Molybdenum trioxide has been reduced by calcium in a sealed bomb to produce massive reguli of molybdenum metal. A full description of the production of 25 lb reguli is given. Reguli have been joined and employed as a consumable electrode in arc melting to produce ingot. Metal has been hot forged and rolled to desired form.

* Present address: Harvey Aluminum, 19200 South Western Ave., Torrance, Calif.

Abstract No. 120

ELECTROPOLISHING FROM THE VIEWPOINT OF SURFACE METALLURGY

C. L. Faust

The discussion will show the nature of a metal surface produced by electropolishing and by tool or abrasive cutting and polishing. The two types of surface conditions (nonmechanically vs. mechanically finished) will be discussed as to effect on appearance, on protection offered by electroplate, on properties of heavy electroplate claddings, on cold deformation, on fatigue strength, on inspection of metals, and on surface reactions.

Abstract No. 121

CHEMICAL POLISHING OF METALLOGRAPHIC SPECIMENS

H. W. Schadler and J. E. Burke

Metal specimens can be satisfactorily polished for microscopic examination by chemical attack. Suitable reagents and techniques are reported for chemically polishing aluminum, cadmium, copper, lead, silicon iron, zinc, and zirconium. It is further shown that smoothing of the surface will result from a uniform rate of solution of the metal surface.

Abstract No. 122

THERMAL ETCHING OF CHROMIUM

M. J. Fraser, D. Caplan, and A. A. Burr

Rolled chromium sheet, when heated at elevated temperatures under purified hydrogen (1 atm) is thermally etched. At 1100°C only grain boundary grooves are developed, but at higher temperatures the surface is striated, leading to various configurations depending on the etching temperature, the orientation of a particular grain with the surface, and local energy variations within the grain. This phenomenon has been observed at four temperatures, 1100°, 1300°, 1400°, and 1500°C.

It has been shown that thermal etching, under the imposed conditions, develops the (100) planes in chromium.

Abstract No. 123

SEGREGATION COEFFICIENT OF SOME GROUP III AND GROUP V ELEMENTS IN GOLD

E. B. Dale and W. L. Mefferd

Effective distribution coefficients for indium and antimony in gold were measured. A strong growth rate dependence of the distribution coefficient of indium was noted.

Abstract No. 124

THE GRAY TIN PHENOMENON: ADDITIONAL DATA

R. R. Rogers and J. F. Fydell

A considerable amount of new data on the gray tin phenomenon will be presented. Included in the discussion will be the results of an investigation of samples from 25 different batches of commercial tin ingots from two different producers. During this investigation the susceptibility of the various batches to gray tin formation was determined using both inoculation and bend methods.

Abstract No. 125

VOLTAMMETRY IN FUSED SALT SYSTEMS*

A. J. Kolk, M. E. Sibert,
and M. A. Steinberg

The kinetics of electrode reactions during

* This paper is based on a portion of the work carried out by Horizons Inc. for the Office of Naval Research, Department of the Navy, Washington, D. C., under Contract Number Nonr-1178 (00).

electrolysis of fused salts is being studied by the technique of constant current voltammetry. A discussion of the equipment and instrumentation in the application of voltammetry to fused salt electrolysis will be given. Some preliminary results obtained in fused salts at 800°C will be presented. The mechanism of some fused salt electrolyses will be discussed in the light of the information gained by this technique.

INDUSTRIAL ELECTROLYTIC

Abstract No. 126

A NEW ELECTROLYTIC PROCESS FOR BRINE WATER BY USING A MERCURY JET CATHODE

Shigeru Mizuno and Shinobu Toshima

An electrolytic cell has been designed with a mercury jet cathode of 0.04-0.20 mm diameter; jet velocity varies from 0.5 to 10 m/sec. The electrolysis of brine water by this cell was carried out, with current density, e.g., 3750 amp/dm^2, NaCl decomposition ratio 11.3%, amalgam concentration 0.13%, and cathodic current efficiency 99.4%. Impurities in brine water have little effect upon electrolysis. Crude NaCl saturated solution was electrolyzed with current efficiency of 96.5%, and 18° Bé saline water with current efficiency of 91.2%.

Abstract No. 127

FACTORS AFFECTING THE FORMATION OF COLOR IN CAUSTIC FROM DIAPHRAGM CHLOR-ALKALI CELLS

R. E. Cushing

The relationship between the source and preparation of graphite used for anodes in

diaphragm chlor-alkali cells on the concentration of the organic color found in the caustic soda produced is discussed. A laboratory evaporator for concentrating commercial caustic solutions from 10% to 50% which operates under conditions similar to those found in the plant but which avoids metallic contamination is described. A table relating per cent transmission and log density of colored solutions is presented.

Abstract No. 128

TECHNICAL ANALYSIS OF DIAPHRAGM CELLS FOR THE ELECTROLYSIS OF NaCl SOLUTION

Takashi Mukaibo*

By simple mathematical treatments, the author analyzed the diaphragm cell for the electrolysis of NaCl solution to get NaOH and Cl_2. The linear differential equations in terms of diffusion, electrolytic migration, and the movement by the flow of the electrolyte through the diaphragm for H^+, OH^-, and Cl_2 dissolved, respectively, were derived. By solving the equations, the author was able to derive the expressions for the current efficiency of obtaining NaOH and its concentration.

Abstract No. 129

PORTABLE ANALYZER FOR THE DETERMINATION OF HYDROGEN AND CHLORINE IN CHLOR-ALKALI CELL GAS

R. E. Cushing and R. S. Reichard

A portable Orsat type analyzer for quickly determining the concentration of hydrogen and chlorine in chlorine gas from electrolytic cells in mains, series, or individual cells is described. The reaction between hydrogen and chlorine is initiated by the photochemical activation of the chlorine molecule using

a conventional light source. The hydrogen chloride is absorbed and the resulting contaction in volume in the specially designed burette indicates directly the percentage of hydrogen in the sample. The analyzer also provides for determination of the concentration of chlorine in the cell gas by subsequent absorption.

Abstract No. 130

THE DE NORA FLUENT AMALGAM CELL

Vittorio de Nora, Patrizio Gallone,
and Giovanni Trisoglio

The electrolysis of alkali chlorides in mercury cells has been utilized industrially for about half a century. A new type of amalgam cell has now been developed which utilizes amalgam flowing vertically along a supporting element and which has a diaphragm to separate the cathode compartment from the anode compartment. The main features of this cell are described together with performance data and other characteristics. Current efficiency is above 96% and average voltage less than 4.3 at normal load. This compact and efficient cell introduces many interesting features and shows very promising results.

Abstract No. 131

THE INFLUENCE OF IMPURITIES IN THE ELECTROLYTE IN CHLORINE-CAUSTIC ELECTROLYSIS BY THE MERCURY CELL PROCESS

V. Further Investigation of the Influence of Metals on Cathodic Current Efficiency

Gösta Angel, Tage Lundén,
Stig Dahlerus, and Rolf Brännland

In a number of electrolysis experiments the influence of mixtures of certain common

metals, such as V, Mg, and Al, was investigated. A theory is developed for the action of those metals which have previously been shown to interfere with the electrolysis in mercury cells.

Abstract No. 132

THE LITHIUM INDUSTRY

P. E. Landolt

Although lithium is in the alkali group of elements, it exhibits many properties characteristic of the alkaline earth group. In the development of nuclear phenomena, lithium becomes quite important. Lithium 6 is a source of tritium. Lithium combines with hydrogen (1, 2, or 3) to form a stable hydride. Three major processes of recovery are in use: (a) treatment with bisulfate of potassium; (b) treatment with sulfuric acid; (c) treatment with lime. Of particular interest to the electrochemist is the production of lithium metal and lithium hydride. The paper discusses the electrolysis of a molten lithium chloride bath containing potassium chloride. Lithium hydride is produced in an electrically heated furnace in which the metallic sodium is melted and dry hydrogen is introduced to form lithium hydride--a salt-like product of high purity. This paper mentions the principal producers of lithium products, production capacities, and the diversified uses of such products. Some details of the economics of lithium uses are outlined and a selected bibliography is given for further reference.

Abstract No. 133

THE CURRENT EFFICIENCY OF FLUORINE CELLS*

* This work was done at the Oak Ridge Gaseous Diffusion Plant operated for the Government by Union Carbide and Carbon Corporation.

J. Dykstra and G. H. Montillon

Current efficiency measurements made on operating fluorine cells by the Carbide and Carbon Chemicals Co. show the advisability of structural design changes and the desirability of certain operating conditions. Both anode and cathode current efficiencies were determined. From temperatures of 88°-114°C, hydrogen fluoride concentrations of 39.7-42%, and current densities from 32 to 125 amp/cm^2, current efficiencies of new cells ranged from 92-97%. If breakage of anodes occurs, the current efficiency may decrease to 75 or 80%.

Abstract No. 134

PROGRESS OF IMPROVEMENTS IN MATERIALS OF CONSTRUCTION OF FLUORINE CELLS*

J. Dykstra and G. H. Montillon

In industrial production of fluorine, the cell life depends largely on materials and methods of construction. Previously cells have been fabricated from steel, magnesium, and monel. Over a five-year period considerable data has been collected at Carbide and Carbon Chemical Company's two ton per day fluorine plant operated for the Government. The materials of construction used in the improved cell described have extended service life by a factor of approximately three times. This paper compares the various interim materials used with comparable service life and corrosion information. Photographic slides will be presented to show stress relieving and corrosion effects.

* This work was done at the Oak Ridge Gaseous Diffusion Plant operated for the Government by Union Carbide and Carbon Corporation.

Abstract No. 135

NEW CONTINUOUS PROCESSES FOR PRODUCTION OF BERYLLIUM HYDROXIDE AND BERYLLIUM METAL

C. W. Schwenzfeier, Jr.

Old beryllium chemistry has been supplemented with modern automation methods and the use of organic reagents for impurity separation to give a new automatic process for production of high purity, high beryllium content beryllium hydroxide. In conversion of this hydroxide to high purity metallic beryllium, new purification techniques have been developed. Recently developed equipment for continuous conversion of ammonium beryllium fluoride to beryllium fluoride at elevated temperatures will be described.

Abstract No. 136

ELECTROCHEMICAL PREPARATION OF BORON

N. F. Murphy, R. S. Tinsley,
and G. F. Meenaghan

A new process for preparing boron by electrolysis of molten alkali oxide-alkali borofluoride-boron oxide mixture, at 750°-875°C, from 0.5-5.0 cathode amp/cm^2 has been discovered and studied. Either potassium or sodium salts with a steel cathode and graphite anode may be used. The only appreciable impurity that exists, when optimum conditions are used, is carbon (about 2%) which results from decrepitation of the graphite crucible and anodes. The current efficiency for the process depends on conditions, and ranges up to 73%. A gas fired furnace is used to avoid corrosion of resistance elements by fumes.

Abstract No. 137

ELECTROLYTIC CRYSTAL GROWTH OF TITANIUM*

Q. H. McKenna, M. E. Sibert,
and M. A. Steinberg

An investigation has been carried out to determine the effect of various conditions on cathodic crystal growth of titanium from fused K_2TiF_6 in NaCl. These conditions have included concentration effects of the melt constituents, temperature, and cathodic current density. Results have been evaluated in terms of type of crystals produced, particle size, current efficiency, and microscopic or macroscopic examination. Titanium is generally deposited as large thin plate-like crystals, but changes in electrolysis conditions can produce fine powders, coarse crystals, or no deposit.

* This paper is based on a portion of the work carried out by Horizons Inc. for the Office of Naval Research, Department of the Navy, Washington, D. C., under Contract Number Nonr-1178 (00).

Abstract No. 138

ELECTRODEPOSITION OF TITANIUM ON BASE METALS*

M. E. Sibert and M. A. Steinberg

A method for electrodeposition of protective titanium coatings on steel and other base metals is described. The procedure involves electrolysis of potassium titanium fluoride in an alkali or alkaline earth halide flux under an inert atmosphere. Graphite

* This paper is based in part on work carried out by Horizons Inc. for the Aeronautical Research Laboratory, Wright Air Development Center, U. S. Air Force, under Contract Number AF-33(616)-393.

or titanium metal anodes are employed. Adherent titanium coatings up to 0.005 in. in thickness are produced. The mechanism is diffusive in nature and a firm base metal-titanium bond results. Coatings so produced possess the corrosion resistance of titanium metal. Heavier layers may be applied if desired by repeating the process. The equipment and materials used, conditions of operation, and properties of the electrodeposited titanium are completely described.

THEORETICAL ELECTROCHEMISTRY and INDUSTRIAL ELECTROLYTIC

Abstract No. 139

THERMODYNAMICS OF FUSED ELECTROLYTES

Carl Wagner

Mixtures of fused electrolytes may be virtually ideal solutions, but distinct deviations from ideality may also occur as has been shown especially by Hildebrand, Salstrom, Flood, Förland, and their associates. The thermodynamic behavior of multicomponent ionic melts may be described in terms of activities of the constituent salts. In reciprocal salt pairs the choice of the independent variables becomes an important problem, especially in conjunction with applications of the Gibbs-Duhem equation.

Abstract No. 140

ELECTRICAL CONDUCTANCE AND IONIC MIGRATION IN MOLTEN SALTS

E. R. Van Artsdalen, I. S. Yaffe, and F. J. Miller

Theories of electrical conductance in

molten salts are discussed in the light of some of the more modern studies of conductance and our fragmentary knowledge about the structure of liquid salts. Additional information can be obtained by tracer studies of diffusion and some investigations of this type are described. Relationships between conductance and diffusion are considered with particular reference to transport numbers. Electrical conduction, diffusion, and viscous flow are considered as rate processes and their heats and entropies of activation are compared and interpreted.

Abstract No. 141

ELECTRIC CONDUCTANCE, TRANSPORT, AND VISCOSITY IN MOLTEN SYSTEMS WITH SPECIAL REFERENCE TO MOLTEN SILICATES AND BORATES

J. O'M. Bockris and G. W. Mellors

Experimental methods of use in the investigation of the above properties in molten systems are outlined and discussion is given of the methods which may be employed in the investigation of the structure of molten systems. Some of these methods are illustrated by application of the systems containing lead ions in borate and silicate systems, and the structure of these systems correspondingly discussed.

Abstract No. 142

TRANSFERENCE NUMBERS OF CATIONS AND ANIONS IN FUSED SILVER NITRATE AND SILVER NITRATE-SODIUM NITRATE MIXTURES

F. R. Duke and Richard Laity

It is shown that one needs data of the Hittorf-cell type in conjunction with data from the moving-bubble cell to determine the transport numbers in mixtures. A description of the operation of the moving-bubble cell to

determine transport numbers in pure silver nitrate is described. The results of this experiment and of similar experiments on silver nitrate-sodium nitrate mixtures are discussed.

Abstract No. 143

TRANSPORT NUMBERS IN PURE FUSED THALLIUM(I) CHLORIDE

Richard Laity and F. R. Duke

The transport numbers of the ions in TlCl are determined by the moving bubble method. The values obtained are compared with the transfer number of Tl^+ in TlCl as determined by Klemm using the self-diffusion coefficient of Tl^+ which he determined.

Abstract No. 144

KINETICS OF ELECTRODE PROCESSES IN FUSED SALTS

Paul Delahay

Electrode processes involving a single rate-determining step can be characterized by a rate constant k^o at the standard potential. The constant k^o cannot be determined by conventional polarization experiments because electron transfer is too rapid. Three different methods can be applied: (a) electrolysis with superimposed alternating voltage; (b) electrolysis with superimposed voltage represented by a square-wave; and (c) electrolysis with a current impulse represented by a step function. The first two methods can be applied for $k^o \leqslant 1$ cm sec^{-1}; the third method for $k^o \ll 10^3$ cm sec^{-1} (approximately the upper limit of possible values of k^o).

Abstract No. 145

IMPEDANCE MEASUREMENTS AT SOLID ELECTRODES IN MOLTEN LITHIUM CHLORIDE-POTASSIUM CHLORIDE

H. A. Laitinen and R. A. Osteryoung

Impedance measurements have been made at solid microelectrodes in molten potassium-lithium chloride eutectic, and in dilute solutions of platinum (II), nickel (II), and cobalt (II) in the eutectic as a solvent. Capacitance and resistance measurements are described for forward (cathodic) polarization of a platinum microelectrode, and for reverse polarization of the plated microelectrode. Results are interpreted in the light of a theoretical interpretation of pseudocapacity.

Abstract No. 146

PURIFICATION OF LITHIUM CHLORIDE-POTASSIUM CHLORIDE EUTECTIC AS A POLAROGRAPHIC FUSED SALT SOLVENT

H. A. Laitinen, W. S. Ferguson, and R. A. Osteryoung

Hydrolytic decomposition occurs during fusion of a eutectic mixture of KCl-LiCl containing traces of moisture if conditions are uncontrolled, resulting in a solvent contaminated by hydroxyl ion which is reactive toward silica. The effectiveness of various purification procedures was followed by observation of polarographic residual currents using a platinum microelectrode. A sequence of purification operations, including heating the solid mixture in a dry HCl stream, evacuation, fusion, and electrolysis of the melt, is described.

Abstract No. 147

GALVANIC FUNCTIONS OF CELLS WITH MOLTEN SALT ELECTROLYTES
I. The Nominal System Mg | KCl-LiCl(l) | Ni

S. M. Selis, G. R. B. Elliott, and L. P. McGinnis

A study of the galvanic mechanism of the system is reported. At lower temperatures, the cathodic reaction is the reduction of hydroxide ion to form hydrogen gas and oxide ion. At higher temperatures, it is the reduction of nickel (II) oxide preformed by nongalvanic oxidation by the electrolyte. In both cases, the anodic reaction is the oxidation of magnesium to magnesium oxide. Small amounts of water, hydroxide ion, and oxide ion in the electrolyte are due to the hygroscopicity of the salts and some hydrolysis occurring as the latter are heated.

Abstract No. 148

GALVANIC FUNCTIONS OF CELLS WITH MOLTEN SALT ELECTROLYTES
II. The Nominal System Mg | KCl-LiCl-K_2CrO_4(l) | Ni and the Effects of Added Solid Acidic Oxides

S. M. Selis and L. P. McGinnis

The inclusion of solid acidic oxides, e.g., silica, results in the augmentation and stabilization of null potentials and the diminution of cell capacities. This is explained in terms of equilibria involving water, silica, and hydroxide, oxide, and silicate ions. The very slow discharge of the system results in a time-potential curve of discrete plateaus shown to be due to the successive reduction of oxides of nickel and to the reduction of hydroxide ion.

Abstract No. 149

SODIUM-ALUMINUM EQUILIBRIA IN CRYOLITE-ALUMINA MELTS

Morris Feinleib and Bernard Porter

In an attempt to shed more light on the cathode reaction in the aluminum reduction cell, a quantitative study of aluminum-sodium equilibria in cryolite-alumina melts was undertaken. Since sodium is almost insoluble in aluminum, lead was used as an auxiliary metal phase to pick up sodium, and the equilibrium concentration of Na in Pb was determined. In order to correlate concentrations and activities of sodium in lead, a series of concentration cells were set up and the emf of various Na-Pb alloys against pure Na and other Na-Pb alloys was measured. Results show that, while aluminum is more noble than sodium, their deposition potentials are not very far apart and that, under the nonequilibrium conditions existing in an industrial cell, some sodium must be co-deposited at the cathode.

Abstract No. 150

ELECTROCHEMICAL CHARACTERISTICS OF MELTS IN THE Sb-Sb_2S_3 SYSTEM

Tsutomu Yanagase and G. Derge

Liquid Sb and Sb_2S_3 were equilibrated at various temperatures and electrolyzed with the metal phase as anode and the sulfide phase as cathode. Current efficiencies varied below 60% and analysis of the data indicated that the balance of the current should be accounted for by the electronic character of the melt rather than losses or side reactions. This was confirmed by direct measurement of the conductivity of the melt as a function of its composition.

Abstract No. 151

LIQUIDUS CURVES FOR ALUMINUM CELL ELECTROLYTES
I. Cryolite-Alumina

N. W. F. Phillips, R. H. Singleton, and E. A. Hollingshead

Liquidus curves for the system cryolite-alumina up to 1050°C and 16% alumina have been determined by means of cooling curves and visual examination of the cooling melt. The freezing point of cryolite is 1006°C with a eutectic point at 959°C and 9.5% alumina. On the alumina side of the eutectic, crystallization is sluggish and there is no break in the cooling curve corresponding to the initial appearance of crystals in the melt.

Abstract No. 152

LIQUIDUS CURVES FOR ALUMINUM CELL ELECTROLYTES
II. Ternary Systems of Cryolite-Alumina with Aluminum Fluoride, Sodium Fluoride, and Sodium Chloride

N. W. F. Phillips, R. H. Singleton, and E. A. Hollingshead

Liquidus curves for those parts of the systems molten at 1050°C have been determined by means of cooling curves and visual examination of the cooling melt. The binary systems of cryolite with sodium fluoride, sodium chloride, and aluminum fluoride gave, respectively: eutectic point at 882°C, 40% sodium fluoride; eutectic point at 734°C, 68.5% sodium chloride; peritectic point at 734°C, 30% aluminum fluoride, and eutectic point at 693°C, 40% aluminum fluoride. Diagrams for the three ternary systems have been made.

Abstract No. 153

CONCENTRATION POLARIZATION AND OVERVOLTAGE

C. V. King

Theories of overvoltage deal with the chemical or electrochemical polarization at an electrode surface. In the measurements, concentration gradients are always present, and must be made negligible, corrected for, or included in the theoretical treatment. This paper discusses the magnitude of concentration polarisation to be expected in the measurement of hydrogen overvoltage, and demonstrates a very simple method of calculating its effect.

Abstract No. 154

ION DISTRIBUTION DURING ELECTROLYSIS

H. P. Dangler* and H. B. Linford

A new theory, based on the thermodynamics of the steady state, is developed to determine the concentration gradient of an electrolyte in the cathode film. The theory is validated by experimental data on the concentration gradients of four electrolytes. The experimental technique involved operating a specially constructed cell so that, as steady state was approached, the cathode film was increased more than two hundred times its usual thickness and, therefore, the concentration gradient could be readily determined.

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Abstract No. 155

FUNDAMENTAL THERMODYNAMICS AND KINETICS OF ELECTRODE PROCESSES

Pierre Van Rysselberghe

Expressions for anodic and cathodic reaction velocities are written in terms of electrochemical and chemical potentials of the reacting species and of the reaction complexes. Conditions bringing about coincidence with Tafel expressions are analysed and rational definitions of the transfer coefficients are established. So-called exchange currents are discussed. The limiting case of small overvoltages is examined. The case of hydrogen overvoltage is examined as a typical example of the proposed theory.

Abstract No. 156

SOME APPLICATIONS OF THE THERMODYNAMICS OF IRREVERSIBLE ELECTROCHEMICAL PROCESSES

Pierre Van Rysselberghe

The thermodynamics of irreversible processes, when applied to simultaneous electrode reactions, and in particular to those involved in corrosion and its prevention, leads to interesting views on corrosion inhibition and cathodic protection. The same type of approach leads to considerable clarification of the conditions under which codeposition, regarded as a case of thermodynamic coupling, can be expected to occur.

Abstract No. 157

ELUCIDATION OF THE TRUE MECHANISM OF HYDROGEN EVOLUTION
I. Quantitative New Consecutive Theory on Smooth Platinum Electrode

A. M. Azzam

Specific velocities of the different stages of hydrogen evolution at smooth platinum electrodes in normal HCl solution and the course of the Tafel line over the range 10^{-3}-200 amp/cm^2 have been successfully calculated. The most probable mechanism is a rapid discharge process, followed by slow consecutive desorptive reactions (catalytic at low current densities, electrochemical at high current densities). Further, the hysteresis in the -log i curves has been quantitatively treated and attributed to slow surface diffusion.

Abstract No. 158

MECHANISMS OF HYDROGEN PRODUCING REACTIONS ON PALLADIUM

J. P. Hoare and Sigmund Schuldiner

The hydrogen overvoltage on palladium in H_2SO_4 and H_2SO_4 + Na_2SO_4 solutions was determined. Data showed that the overvoltage curves could be divided into three consecutive regions: (a) η was linearly dependent on i; (b) there was a Tafel relationship between η and i in which the b slope, depending on the pH of the solution, was equal to 0.030 to 0.042; (c) depending on the pH of the solution, there was either a Tafel relationship between η and i with a b slope of 0.12, or η was independent of i. Hydrogen overvoltage mechanisms were postulated for each of these regions.

Abstract No. 159

HYDROGEN OVERPOTENTIAL ON SILVER SINGLE CRYSTALS

H. B. Morley and F. E. W. Wetmore

The rate of potential build-up has been determined on both polycrystalline and single crystal silver electrodes in 2N sulfuric acid

at low current densities. Overpotentials and decay rates of the potential have also been studied. The mechanism is discussed in the light of the information obtained.

Abstract No. 160

HYDROGEN OVERPOTENTIAL STUDIES ON ALUMINUM

D. J. Hansen and F. E. W. Wetmore

Hydrogen overpotentials have been measured with impure and very pure aluminum electrodes in 0.1N sulfuric acid at low current densities. The effect of the local corrosion current on the overpotential-current relationship is shown.

Abstract No. 161

CALCULATION OF THE EFFECT OF CATIONIC SPECIFIC ADSORPTION ON THE PROTON DISCHARGE RATES AT MERCURY AND OTHER CATHODES

B. E. Conway, J. O'M. Bockris, and B. Iovrocek

Potential energy diagrams are calculated for the discharge of specifically adsorbed proton-donating cations at mercury and compared with those for the hydroxonium ion. Rates of discharge are determined by the acid dissociation constant of the proton source and its specific adsorption potential calculated from determinations of electrocapillary data. Calculations predict catalytic effects on discharge rates of quinoline alkaloids and inhibitory effects of isoquinoline alkaloids, which are verified by experimental measurements of overpotential.

Abstract No. 162

THE INFERENCE OF ADSORPTION FROM DOUBLE-LAYER CAPACITANCE MEASUREMENTS

B. H. Clampitt* and R. S. Hansen

The apparent isotherms for the adsorption of n-caproic acid, n-heptylic acid, n-octanoic acid, heptanol-1, and n-heptaldehyde from 0.1M aqueous perchloric acid solution by silver and copper were obtained from double-layer capacitance measurements. Results are compared with corresponding results for these systems obtained by steady-state current-overvoltage measurements. It is shown that the apparent isotherms can be reasonably interpreted as actual adsorption isotherms.

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Abstract No. 163

THE KINETICS OF THE OXYGEN ELECTRODE ON ACTIVE CARBON*

Myron Davies,** Milton Clark, Ernest Yeager, and Frank Hovorka

Polarization measurements by the commutator method indicate that the oxygen-perhydroxide couple is substantially reversible on active carbon in basic solutions even at appreciable current densities. Cathodic and anodic polarizations are primarily associated with transport processes involving molecular oxygen and perhydroxide anions. Surface areas of the active carbons have been determined by gas adsorption measurements. The use of oxygen-18 also affords information

* Research partially supported by the Office of Naval Research.

** du Pont Fellow, 1954-55.

concerning the nature of the oxygen species involved in the oxygen-perhydroxide couple.

Abstract No. 164

DISSOLUTION OF METALS IN ACIDS III. Kinetics

A. C. Makrides

A quantitative theory for an electrochemical mechanism of dissolution of metals in acids is developed. The rate is given by $v = ka^P$, where k is a constant given in terms of the kinetics of two half-cell reactions and the difference of their reversible potentials, a the acid activity, and P a temperature independent constant. The heat of activation for dissolution is calculated to be the weighted sum of the energies of activation of the anodic and cathodic processes at their respective reversible potentials and of the equilibrium enthalpy change for the over-all reaction. Experimental results, when correctly analyzed, are in good agreement with calculated values.

Abstract No. 165

ANODIC POLARIZATION OF TITANIUM IN NONAQUEOUS BASE ETCHING SOLUTIONS

Morris Eisenberg and R. E. De La Rue

Results of systematic studies of the anodic polarization of titanium in nonaqueous electrolytic etching baths containing small amounts of water are described. Solvents included ethylene glycol, dioxane, and tetrahydrofuran. A direct method, using nickel reference electrodes, was employed. The studies covered a current density range from 0 to 160 ma/cm^2 at temperatures from 35° to 95°C. Results are interpreted in terms of the mechanism of the anodic process and are employed to obtain optimum conditions for

electrolytic etching of titanium in preparation for deposition of protective coatings.

Abstract No. 166

OXIDE FILM FORMATION ON THE SURFACE OF METALS IN AQUEOUS SOLUTIONS AND THE EVALUATION OF THEIR STANDARD POTENTIALS III. The Lead Electrode

S. E. S. El Wakkad and T. M. Salem

The behavior of the lead electrode in solutions of varying pH and initially free from lead ions has been examined from the extreme acid to the extreme alkaline range and the probable existence of an oxide film on the surface of the metal is discussed. A new apparatus and technique are described for measuring the potential of lead out of contact with air. The standard electrode potential of lead is determined by using this new technique and is compared with the value in air.

Abstract No. 167

ANODIC OXIDATION OF ZINC AND ZINC-TIN ALLOYS AT VERY LOW CURRENT DENSITY

S. E. S. El Wakkad, A. M. Shams Eldin, and H. Kotb

This study is related with previous studies carried out by the authors on the anodic oxidation of metals at very low current density. The results obtained are as follows: (a) zinc becomes passive at very low current density in sodium borate solution of pH 9.2; (b) zinc-tin alloys become passive at very low current density in sodium borate solution of pH 9.2 and sodium carbonate solution of pH 11.5 owing to the consecutive formation of ZnO, $Sn(OH)_2$, and $Sn(OH)_4$ before oxygen evolution. Results have been verified from studying current-potential curves and

determining the "critical current densities" for passivation.

Abstract No. 168

ANODIC OXIDATION OF METAL IONS TO INSOLUBLE HIGHER OXIDES WITH SPECIAL REFERENCE TO MANGANESE DIOXIDE

H. K. Chakrabarti and T. Banerjee

The phenomena of anodic oxidation of metal ions to insoluble higher oxides cannot be satisfactorily explained on the basis of electrode potential or by postulating intermediate formation of unstable peroxides of electrode material, hydrogen peroxide, or persalts. An attempt has been made to correlate the oxidation process with the anodic double layer containing discharged and charged anions and cations. The possibility of extension of the scope of the proposed mechanism has also been indicated.

Abstract No. 169

THE KINETICS OF FORMATION OF ANODIC Ta_2O_5: FURTHER STUDIES

D. A. Vermilyea

An investigation of the formation of anodic Ta_2O_5 films under constant voltage conditions has shown that conclusions drawn from earlier data obtained using constant current conditions are incorrect. The new data show that the activation energy for the process is not a single linear function of the field, and that the pre-exponential factor is also a function of the applied field. Possible mechanisms are considered, but none adequately explains the results.

Abstract No. 170

MATHEMATICAL STUDIES OF GALVANIC CORROSION II. Coplanar Electrodes with One Electrode Infinitely Large and with Equal Polarization Parameters*

J. T. Waber and Marshall Rosenbluth

The distribution of current density as well as variation of the interfacial potential over the anode has been derived in terms of Fourier integrals and evaluated for the conditions that one electrode is infinitely larger than the other and that the Wagner polarization parameters of the two electrodes are equal. The minimum and maximum current density, obtained for a wide range of values of the characterizing parameter ($a/\mathcal{L}$), show the distribution of current density is more uniform for small values.

* Work done under the auspices of the Atomic Energy Commission.

Abstract No. 171

MATHEMATICAL STUDIES OF GALVANIC CORROSION III. Semi-Infinite Coplanar Electrodes with Equal Constant Polarization Parameters*

J. T. Waber

Mathematical analysis in terms of a Fourier series of a coplanar array of long, narrow electrodes immersed in an infinitely deep electrolyte has been made subject to the condition that the anodic and cathodic polarization parameters were equal and constant. The variation of interfacial potential and distribution of current density over the anode has been computed for values of the characterizing parameter ($a/\mathcal{L}$) and of the

* Work done under the auspices of the Atomic Energy Commission.

anodic fraction (a/c). Experimental studies agreed reasonably well with the theory.

Abstract No. 172

MATHEMATICAL STUDIES ON GALVANIC CORROSION IV. Influence of Electrolyte Thickness on the Potential and Current Distributions over Coplanar Electrodes Using Polarization Parameters*

J. T. Waber and Bertha Fagan

The potential distribution in a finite electrolyte lying above a plane containing long, narrow, juxtaposed electrodes and the variation of current density over the anode has been evaluated. When the relative thickness is small, the major part of the current is concentrated in the vicinity of the anode-cathode junction. Finite electrolyte thicknesses greater than the sum of the anode and cathode widths are effectively "infinite." Agreement with experimental data is reasonably good.

* Work done under the auspices of the Atomic Energy Commission.

Abstract No. 173

POLAR PROPERTIES OF SOLVENT AND THE CONDUCTANCE OF ELECTROLYTES AT INFINITE DILUTION

E. S. Amis

The deviation from Walden's rule calculated as ionic radii show solvation to be selective with the ions clinging preferentially to the more polar constituent of the solvent even at relatively low concentrations (20% or less) of this component. An effective distance of electrostatic attraction of ions and molecules is found to be fairly constant for different solutes in different

mixed solvents due to the cancellation of the effect of the moment in the numerator and the dielectric constant in the denominator of the mathematical expression for this distance of electrostatic attraction.

Abstract No. 174

THE HEAT OF HYDRATION OF METALLIC IONS

A. L. Bisio*

The ionic heats of hydration for metal ions derived for metal belonging to the first and second groups of the periodic table have been calculated from the properties of the metal and the solvent. The proposed theory assumes bonding to exist between the metal on the ion and the solvent (water) molecule with the formation of various resonance structures. The resonance energy and the ionic heats of hydration are then calculated using molecular orbital techniques.

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Abstract No. 175

CONDUCTANCES, VISCOSITIES, AND DENSITIES OF SOLUTIONS OF POTASSIUM THIOCYANATE IN METHANOL AT TEMPERATURES WITHIN THE RANGE 25°-50°C*

P. G. Sears, R. R. Holmes, and L. R. Dawson

Conductances, viscosities, and densities have been determined for solutions of potassium thiocyanate in methanol at nine temperatures within the range 25°-50°C. Concentrations of potassium thiocyanate ranged from

* Based on research performed under contract No. DA 36-039-sc-42581 for the U. S. Army Signal Corps.

4×10^{-4} to 1.75N. Good agreement exists between the observed behavior and the theoretical Onsager relationship for dilute solutions at all temperatures used in this study. The variation of conductances and viscosities of the more concentrated solutions is discussed with respect to both concentration and temperature.

Abstract No. 176

THE CONDUCTANCE OF LITHIUM BROMIDE AT LOW CONCENTRATIONS IN METHANOL WITHIN THE TEMPERATURE RANGE 20° TO -50°C*

P. G. Sears, R. L. McNeer,**
and L. R. Dawson

The conductance of lithium bromide in methanol has been determined over the temperature range 20° to -50°C for several concentrations ranging from 4×10^{-4} to 1×10^{-1}N. Limiting equivalent conductances were obtained by extrapolation of Λ'_o vs. C plots. Fair agreement exists between experimental and theoretical conductance behavior of lithium bromide in dilute methanol solutions. A plot of the logarithm of the limiting equivalent conductance in methanol as a function of the reciprocal of the absolute temperature over the range 20° to -50°C was found to be linear and to have the same slope as several corresponding plots constructed from experimental data for low concentrations.

* Based on research performed under Contract No. DA-36-039-sc-5398 for the U. S. Army Signal Corps.

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Abstract No. 177

CONDUCTIMETRIC AND VISCOMETRIC BEHAVIOR OF LITHIUM BROMIDE IN 50-50 WEIGHT PER CENT METHANOL-ACETONE AT TEMPERATURES WITHIN THE RANGE 20° TO -50°C*

L. R. Dawson, R. A. Hagstrom,**
and P. G. Sears

Conductances, viscosities, and densities, at temperatures within the range 20° to -50°C, have been determined for solutions of lithium bromide in 50-50 wt % methanol-acetone over a wide concentration range. An indirect method has been used to evaluate limiting equivalent conductance at temperatures other than 20°C. The logarithm of the conductance-viscosity product has been found to be a linear function of the reciprocal of the absolute temperature for all solutions studied. A linear relationship has been found also between the logarithm of the equivalent conductance and the logarithm of the viscosity for all solutions over the temperature range studied.

* Based on research performed under a contract with the U. S. Army Signal Corps.

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Abstract No. 178

CONDUCTANCES OF SOME MODERATELY CONCENTRATED SOLUTIONS OF METALLIC PERCHLORATES IN THE MIXED SOLVENT METHANOL-ACETONE AT LOW TEMPERATURES

P. G. Sears, W. W. Wharton,
and L. R. Dawson

Conductances and viscosities of solutions of lithium perchlorate in 50-50 wt % methanol-acetone at concentrations up to 4.75M

have been measured over the temperature range -50° to 20°C. Similar measurements have been made on solutions of magnesium, zinc, and strontium perchlorates to concentrations slightly above 1.0M. It has been shown that these solutes exhibit similar behavior and that properties of solutions of the mixed solutes depend primarily upon the total electrolyte concentration.

Abstract No. 179

ELECTROLYTES OF BINARY SOLUTES IN KETONES

J. E. Lilienfeld, H. Y. Hsiao, and H. S. Myers*

In systems of a ketone, a phenolic compound, and sodium hydroxide, with conductivity as constant parameter, composition functions are referred to weight ratio of sodium hydroxide to phenolic compound as ordinates, and weight per cent of phenolic compound in ketone as abscissas. At about 30%, a minimum is common to the presented functions. This, and other findings, indicate an elementary functional dependence of conductivity on molecular weights of both organic components.

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Abstract No. 180

THE ELECTROCHEMISTRY OF SOME NONAQUEOUS SOLUTIONS OF INORGANIC SALTS

M. C. Henry, W. M. McNabb, and J. F. Hazel

Electrolyses of several anhydrous salts in benzene, quinoline, isoquinoline, and morpholine have been studied. The conductivities and decomposition potentials of the systems were determined. Aluminum and potas-

sium were electrodeposited from their bromides in benzene. Potassium was plated from its thiocyanate in isoquinoline. Lithium was deposited from its chloride in morpholine. Iron was deposited from its chloride in quinoline. The deposits were formed on platinum cathodes.

Abstract No. 181

CONDUCTIVITIES OF RANDOM DISPERSIONS

R. E. De La Rue* and C. W. Tobias

Results of measurements of electric conductivities of random dispersions of monosized and mixed-size nonconducting spheres, cylinders, and irregularly shaped particles in electrolytes are presented. The electric conductivity of a random dispersion is not influenced by particle size or shape; it is dependent only on volume concentration of the dispersed phase and conductivity of the dispersing medium. For $0 < a < 0.5$ (a equals volume fraction of the nonconducting dispersed phase), experimental values can be most satisfactorily predicted by a simple function developed recently by Baron:

$$k_d/k_e = (1-a)^{3/2}$$

where k_d, k_e are conductivities of dispersion and dispersing medium, respectively.

* Present address: Stanford Research Institute, Stanford, Calif.

Abstract No. 182

QUANTITATIVE MEASUREMENTS OF COLLOIDAL VIBRATION POTENTIALS*

* Research partially supported by the Office of Naval Research.

Ernest Yeager, Joseph Dereska,
and Frank Hovorka

The propagation of ultrasonic waves through a colloid in a dilute electrolytic solution produces a periodic distortion of the diffuse layer of ions surrounding each colloidal particle. The net effect is an alternating potential difference in the liquid between points separated by a phase distance other than a multiple of the wave length. Quantitative measurements have been made in colloidal silica with pulse-modulated ultrasonic waves over the frequency range from 200 to 1100 kc/sec. Results are in agreement with theory.

Abstract No. 183

ELECTROKINETIC POTENTIALS OF BULK METALS FROM STREAMING CURRENTS

R. M. Hurd and Norman Hackerman

The streaming currents produced by fluid flow through metal capillaries have been measured, and from this the electrokinetic (ζ) potentials of the bulk metals were calculated. The ζ-potentials of platinum, gold, and silver in contact with distilled water were found to be 60.8, 61.0, and 49.0 mv, respectively. ζ-potentials of the metals were also measured in dilute solutions of KCl and KOH and were found to be related to the solubility of the corresponding metal chlorides and hydroxides.

Abstract No. 184

HIGH PRESSURE OXIDATION OF METALS
Oxidation of Metals Under Conditions of a Linear Temperature Increase

J. P. Baur, D. W. Bridges,
and W. M. Fassell, Jr.

A method of studying the oxidation be-

havior of metals has been developed wherein the metal sample is subjected to a linear temperature increase at constant oxygen pressure. The advantages of this method over previous isothermal methods are given. The linear temperature increase method was applied to the metals Ta, Nb, Mo, Cu, Zr, Mg, Ti, and W. Results are in good agreement with those of previous investigations made in this laboratory. Theoretical considerations show that results could be explained by imposing the conditions of a linear temperature increase on a general type rate equation.

FALL MEETING

at the

WILLIAM PENN HOTEL

Pittsburgh, Pa.

October 9, 10, 11, 12, and 13, 1955

Sessions probably will be scheduled on

Battery

Corrosion

Electrodeposition

Electro-Organics

Electrothermics and Metallurgy

Abstracts for the Fall Meeting (not exceeding 75 words in length) must reach the Secretary's Office, 216 West 102nd Street, New York 25, N. Y.
not later than June 15, 1955
in order to be included in the program

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